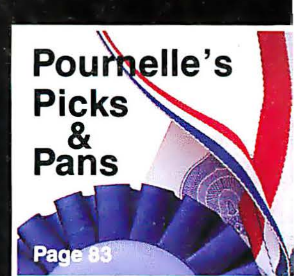
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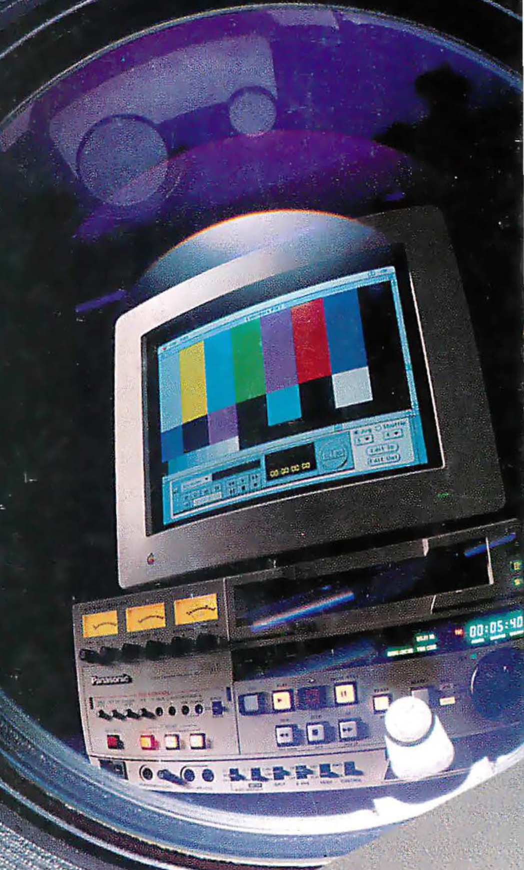
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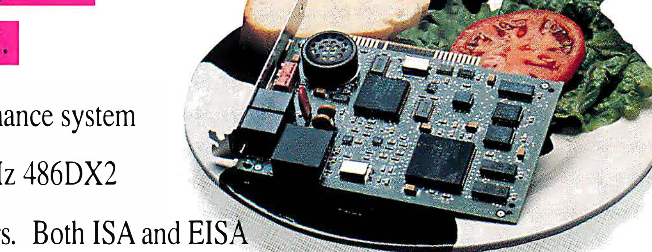


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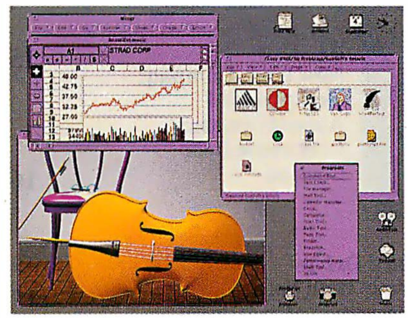
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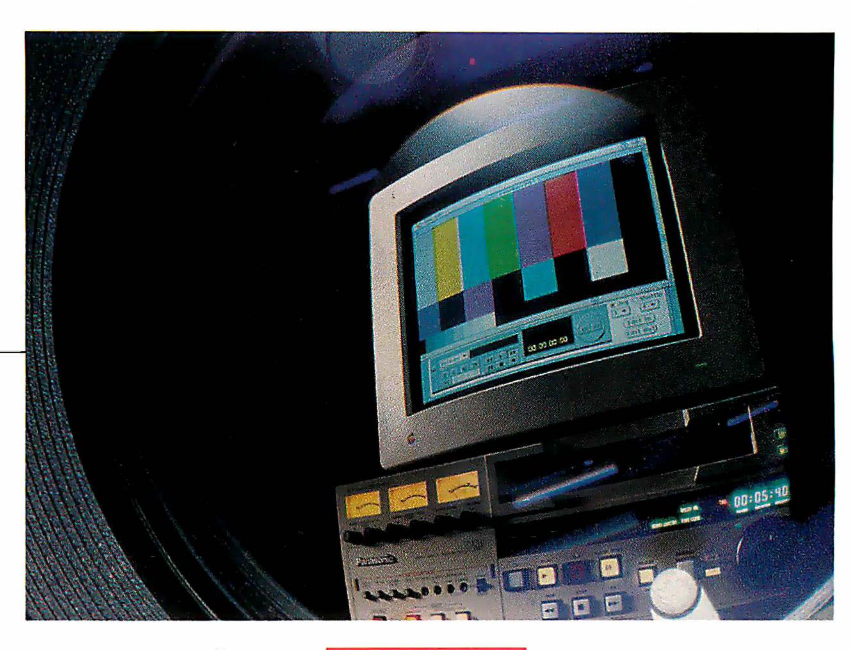
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BYTE

April 1992 *Volume 17, Number 4*



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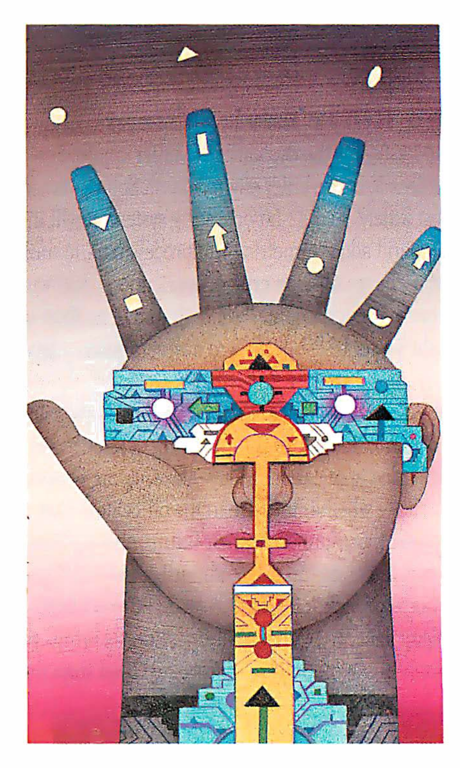
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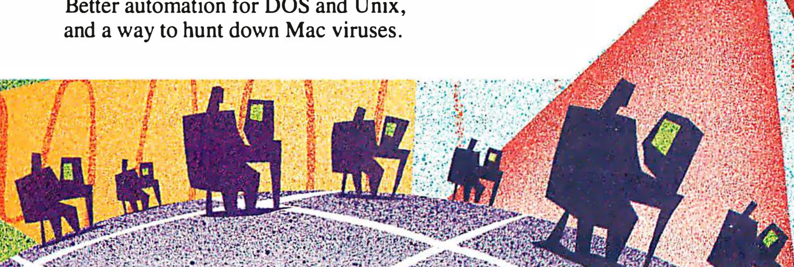
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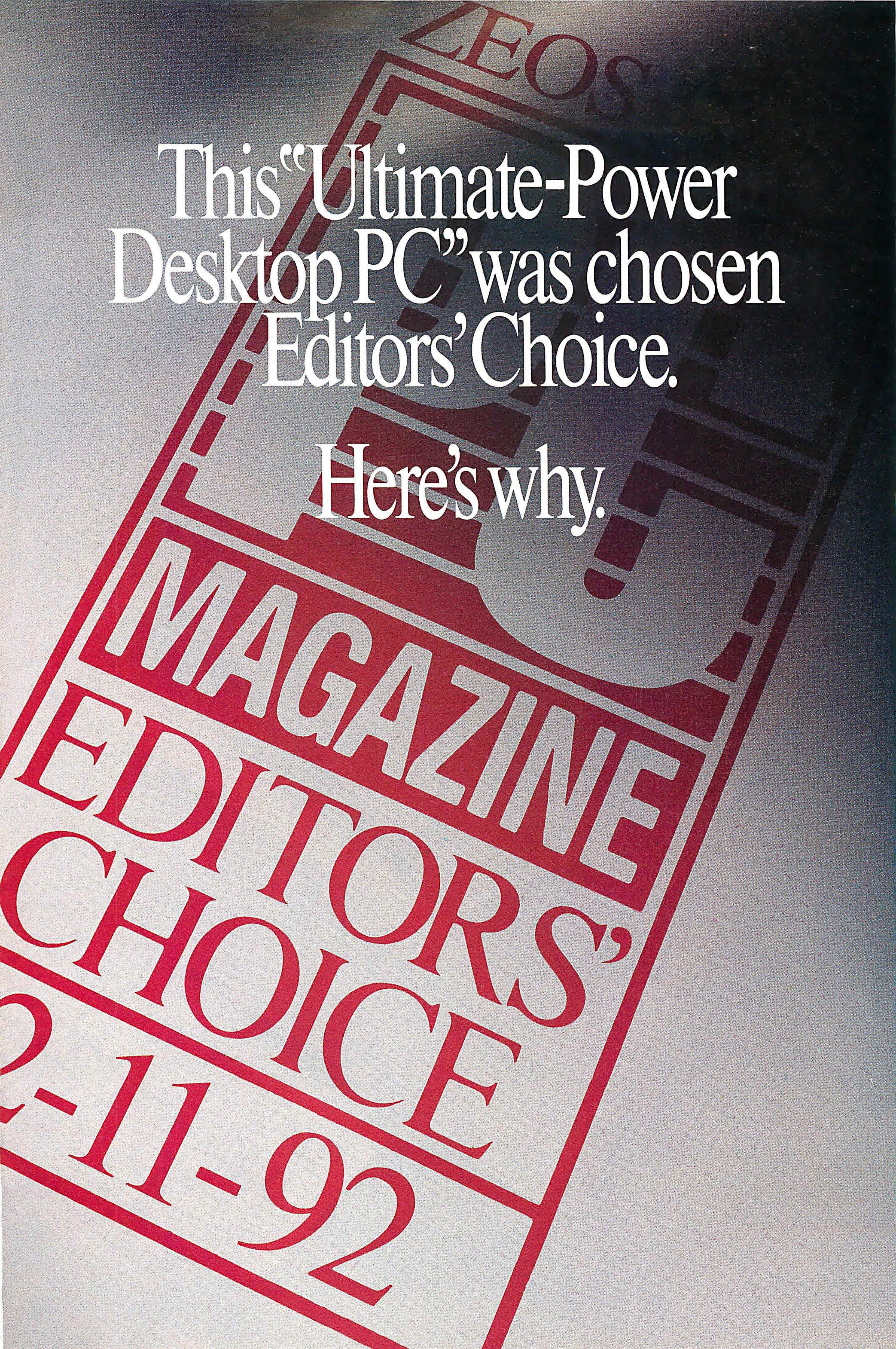


OPINIONS

INSIDE BYTE

ABOUT THE COVER
This month's cover was created by photographer Mark Rockwood in collaboration with ImageSet Design (Portland, ME). Three separate photos, a video camera, and a monitor and keyboard were scanned, color-corrected, and manipulated using state-of-the-art hardware and software from Scitex, Adobe, and Quark. Film was generated with an Agfa Selectset 5000 Imagesetter.

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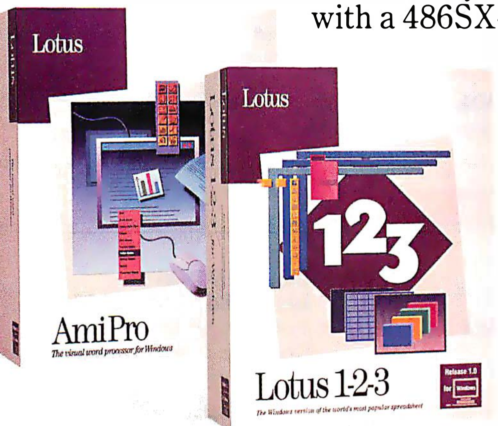


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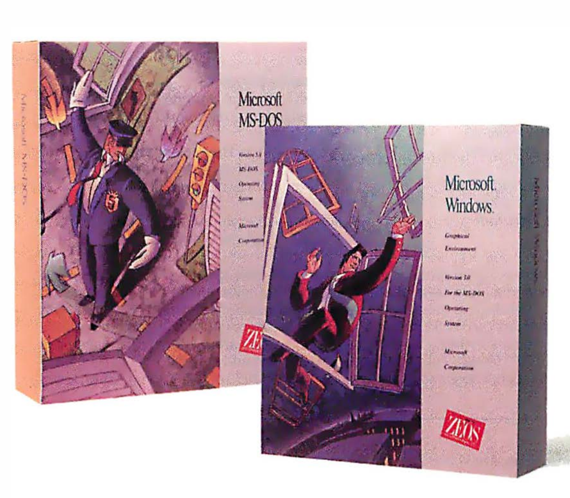
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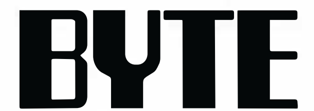
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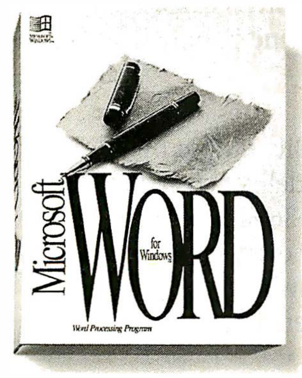
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NSTL TEST RESULTS, DECEMBER 1991

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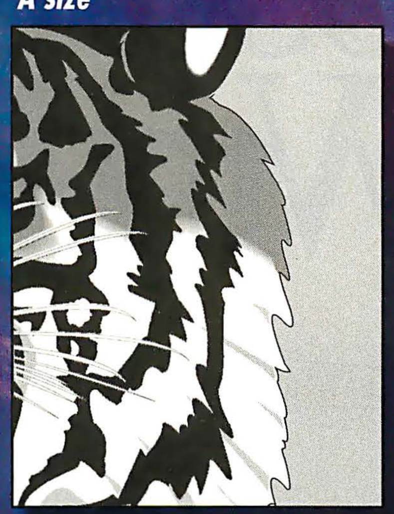
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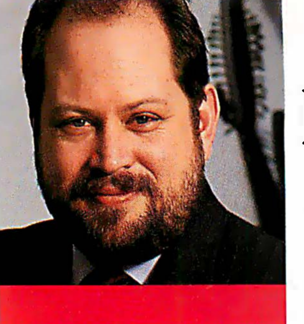
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EDITORIAL

DENNIS ALLEN

PEN-INPUT SYSTEMS

Despite all the hoopla about pen-input systems, is the world ready for them?

Most of the excitement about pen-based computers is unwarranted. Industry gurus have been cheerleading for pen technology for well over a year, and even we carried a cover story last November on the Momenta, which promised to replace the traditional notebook computer. Yet those who are building these machines have not been deluged with orders. The reason is that pen-based systems are too expensive, don't deliver all the functionality needed, and require too much training.

Two paradigms get most of the attention for pen computing. In one, a pen-based system might replace the notebook computer. That is the approach taken by Momenta. The trouble is that a notebook computer is a moving target. Currently, notebook makers are transforming their products into do-everything, portable replacements for desktop systems with color, lots of power, and lots of memory and disk space.

And as if to prove once and for all that a notebook can replace a desktop system, some makers are building desktop "docking stations" to contain the components and add-in cards that don't happen to fit into the notebook itself. Then there's the whole issue of color. How can a notebook replace a desktop system if it doesn't offer high-quality color at a reasonable price? Add to all that the complexity of a pen interface and handwriting recognition, and you have a complicated piece of machinery that even NASA can't afford to build.

The other paradigm is pen computing as an adjunct to existing computers. Consider a small, highly portable computer that literally replaces a pocket-size paper notebook. The idea is that instead of writing notes on paper to later transcribe into your computer, you would simply "write" those notes on the pocket-size pen computer and later transfer that information to your desktop system.

That makes a lot of sense, but there's still one problem: The technology just isn't there yet. Building a pen system to fit into a coat pocket is not too difficult, but packing in enough power to do handwriting recognition—and remain reasonably fast—is a major hurdle for manufacturers to overcome. There's no easy way to pack, say, an alkaline-battery-powered 486 CPU with lots of memory and storage and a pen screen into a 10-ounce package that fits in your coat pocket.

Even if the engineers could, I'm not sure that you'd want to take the time to train it. Handwriting-recognition technology just isn't good enough to deal with everyone's handwriting style, so you have to teach the system how *you* write each letter of the alphabet. Even after training, most pen systems expect you to change the way you write to improve the odds of recognition.

Maybe that wouldn't be so bad if the odds weren't stacked against you. The fact is that most systems ask you to rewrite many characters so that they can be recognized. Isn't this the reason that voice recognition never caught on? If you ever sat in front of a microphone saying "Enter" over and over again instead of just hitting the Enter key, you know what I mean.

This may all sound as though I don't like the idea of pen computing, but that's not true. What I want to see is a pen-based system that truly makes sense. It wouldn't have to fit into my coat pocket, but it would have to be light—under 2 pounds. It would also have to come in a form with which I'm used to working—roughly the dimensions of a sheet of paper and no thicker than a pad of paper. I don't want to give up anything I can do on paper.

My ideal pen-based system would also run all day before recharging if it used rechargeable batteries, or several weeks before replacing the batteries if it used alkaline batteries. It would also have the power and performance to recognize my scribbly, inconsistent handwriting with perfection, and it would do it so fast that I'd not be particularly aware that it was happening.

Most important of all, it would be connected to my desktop system and my office network, so that I could access any information I need when I need it. It could use a wireless LAN when I'm in a conference room at my office building or a cellular connection when I'm away. And, finally, my system would cost only about $2000.

Unfortunately, my ideal system isn't available, and the current offerings don't even come close. When it does become available, you'll probably find it on the cover of BYTE. So the real question is whether pen computing is ready for the world. Except for a few special applications, such as electronic forms, the answer is no, not today.

—Dennis Allen
Editor in Chief
(BIX name "dallen")

IN A CATEGORY OBSE
AND LIGHTER, COMPAQ W
ANOTHER ADJE

Make it smaller. Make it lighter. Make it lighter. Make it smaller.

These must be the mandates emblazoned upon every R&D document handed to the engineers of today's crop of notebook computers.

Admirable goals to be sure. Goals that the engineers at Compaq, however, believe fall well short of making the most of portable computing.

3:30

Accurate to within minutes, the COMPAQ PowerSmart Pack battery gauge clearly displays remaining battery life at the touch of a button.

Which explains why the latest 386SL notebook technology from the labs in Houston — the new COMPAQ LTE Lite/25 and LTE Lite/20 PCs — are not only the lightest (a scant 6 lbs.) and the smallest (only 8.5″x11″x1.75″) notebook PCs that we've ever built. They're also the smartest.

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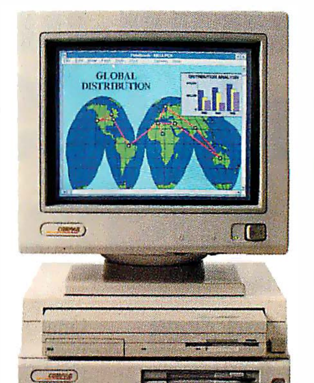
And the energy-saving features in our newest notebooks go far beyond the presence of an Intel 386SL chip.

To make the most of the smarter battery, the new COMPAQ LTE Lite also comes with user-adjustable power-drain settings, and three different sleep modes — System Idle, System Standby, and Hibernation.

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Our optional 9600-bps modem for the COMPAQ LTE Lite PCs would make even Alexander Graham B. proud.

The COMPAQ Enhanced 9600-bps Internal Modem is compatible with the broad base of today's communications protocols.



Just slip the COMPAQ LTE Lite into the COMPAQ Desktop Expansion Base and you're instantly connected. Expansion slots, external ports, and mass storage bays give you immediate access to monitors, networks, hard drives, tape drives, CD-ROM and more. And all the while, built-in security features ensure a safe harbor for your notebook.

In modem talk, that means true V.32 9600-bps data transmission and V.42bis compression for up to 38.4 kbps throughput, as well as full support for Hayes AutoSync.

This little marvel negotiates the fastest transmission throughput that the other end of the line can muster, whether it's sending or receiving.

It even drops to a low power-drain standby state and monitors incoming signals if you're waiting for a call to come in.

Or for that matter, another modem to catch up.

NOT ONLY SMART, BUT BRIGHT.

The new, efficient COMPAQ Maxlight VGA display makes for a much brighter screen than our previous notebooks, and does it without sacrificing battery life.

Sharper graphics and text in up

SSED WITH SMALLER OULD LIKE TO SUGGEST CTIVE: SMARTER.

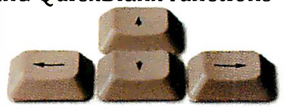
to 64 shades of gray complement an enhanced video subsystem that's so fast it virtually eliminates "submarining," better known as "where did that #%$**# cursor go?"

A NOTEBOOK THAT'S USELESS IN THE WRONG HANDS.

At Compaq, we realize that data security is every bit as important as hardware security.

At the hardware level, DriveLock locks the hard drive, preventing access to data even if the drive is removed.

One-touch QuickLock and QuickBlank functions



Isolated inverted "T" cursor controls are in a familiar position so you don't have to teach your fingers new tricks.

allow you to quickly (surprise) disable the keyboard or blank the screen.

And of course, our new notebooks come with a Keylock slot for an optional cable lock.

With all of the above, plus a 120-MB hard drive,* RAM expansion to 10 MB, cache memory, simultaneous display, and an auxiliary battery, to say these are the best notebooks we've ever made would be something of an understatement.

To back them with a one-year worldwide warranty and our toll-free Compaq Customer Support Center hotline would be more like it.

intel inside

So don't choose between a small notebook and a smart notebook. Choose both.

Choose the new COMPAQ LTE Lite.

For information about our new notebooks or an Authorized COMPAQ Reseller near you, call Compaq in the U.S. at 1-800-231-0900, Ext. 100, or in Canada at 1-800-263-5868, Ext. 100.

COMPAQ

Introducing The COMPAQ LTE Lite

Actual weight: 6 lbs. Actual dimensions: 8.5" x 11" x 1.75". Actually, this is the best notebook we've ever built.

Circle 55 on Inquiry Card.

LETTERS

APL Praise

It was refreshing to read Doris Appleby's "Classic Languages, Part 4: APL" (December 1991). APL deserves much more serious attention both from expert programmers and from managers with difficult problems to resolve.


FEATURE

APL

BYTE ACTION SUMMARY

APL has been described by James Martin as the only language worthy of being called a fifth-generation language. Ironically, it is also one of the oldest languages. APL is the only fully international language, precisely because of its special character set. It is the only language that has been devised for *people* first and then converted to machine use.

Because of its power, the scope of APL is almost certainly far wider than that of any other language. This power makes it unequaled in fields, such as actuarial mathematics, statistics, and operations research modeling, where common languages are terribly cumbersome and tedious to use. This power is equally evident and just as useful in business when there is need for resolving complex questions in a hurry and for adapting to ever-changing conditions.

Georges Brigham
Wilton, CT

Great Road Maps

The article "Distributed Open Environments" (November 1991) is the best I've seen on the subject.

Soon every personal computer will be part of a global network. We need road maps, and we need to know the traffic rules, the rule makers, and the rule-making groups, as well as the products, construction/configuration/architecture, and management techniques. Articles like this are the reason I subscribe to BYTE. Don't spare the detail, and keep up the good work.

George McKee
Houston, TX

More on OS/2 2.0

Jon Udell's "OS/2 2.0: A Pilgrim's Journey" (December 1991) raises more questions than it answers.

First: Where's the software? My favorite mail-order house advertises a hundred products for Windows and not one for OS/2. Did Udell use any OS/2 applications? He doesn't mention any. He says that "potent" OS/2 software "waits in the wings," as has been said since 1987. Meanwhile, as the curtain rises on OS/2 2.0, Lotus uses a four-page color foldout inside BYTE's front cover to tell us about 1-2-3 for Windows.

Second: If OS/2 is a "better DOS than DOS," why is there a multiple boot facility? Substitute "DOS 5.0," a truly better DOS, in place of "OS/2" in one of Udell's remarks and see how it reads: "Even the most partisan DOS 5.0 users occasionally need to boot plain old DOS 3.3." Udell goes on to call the multiple boot facility "one of OS/2 2.0's nicest features." If you found that DOS 5.0 users always keep DOS 3.3 ready on their disks as well, would you accept that as anyone's idea of a "better DOS than DOS"?

Third: Exactly how much does it cost a Windows user, in extra RAM and disk space, to run OS/2? Even if Windows applications run just as well, OS/2 is not "a better Windows than Windows" if it takes more resources to do the same job. Underneath a lot of technospeak about VDM and DPMI, I think that Udell is telling us that it takes a lot more. Windows applications ran "fine" on his 12-MB Systempro but "poorly" on his 4-MB Swan. Yet 4 MB is twice what vendors ship with their "Windows-ready" PCs.

Finally: Will IBM really support OS/2 on non-IBM hardware? When Udell wrote in April 1990 ("OS/2 2.0: It's a Family Affair") that OS/2 2.0 was the system he wanted, it was backed by Microsoft. Now it's in the hands of a hardware vendor whose ads for years suggested that OS/2 required the Micro Channel to run reliably. IBM's current ads don't say that—but they say nothing at all about what machines it will run on or who will provide the software support. Udell succeeded in running OS/2 on his Swan and his Systempro, but I would like to know if this is just an experimental observation, or if IBM certifies and supports it for those platforms. How does the OS/2 list compare with Microsoft's list of nearly 200 platforms that support Windows?

Daniel P. B. Smith
Norwood, MA

"Where's the software?" Although your mail-order house may not prominently advertise the fact, OS/2 versions of many of the most important Windows (and DOS) applications exist. I run OS/2 versions of Smalltalk/V, PageMaker, Epsilon, and HyperAccess, for example, along with OS/2-only gems like the Hamilton C Shell. Of course, that's just the icing on the cake. OS/2 2.0 subsumes nearly all existing DOS and Windows programs, so the answer to your question will be "everywhere" if 2.0's Windows support turns out as well as its DOS support has.

As to multiple boot, it's just plain useful. As a developer, I'd love to be able to use a single machine to test my application under DOS 3.3, 4, and 5, as well as OS/2 1.3 and 2.0. And note that the multiboot feature isn't just a way to fall back to DOS—you can use it to toggle between OS/2 and Unix or other operating systems. Now that you mention it, yes, I think multiple boot would be a nice enhancement to DOS 5.0 as well.

How much extra RAM? As I mentioned, the Windows support in the early version of OS/2 I tested did not yet successfully exploit OS/2's memory manager. Clearly, that's critical. Windows can't be said to run well under OS/2 unless it can perform on a 4-MB machine. Will it? The jury's still out. Note, however, that OS/2 and DOS

WE WANT TO HEAR FROM YOU. *Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or send BIXmail c/o "editors." Your letter may be edited for length and clarity.*

C programmers

Imagine:

interface development & screen management in a utopian environment!

In the perfect world, you probably wouldn't choose to spend excessive time and energy (read: any) sweating the interface to satisfy the constantly changing whims of your end-users. On the other hand, the perfect world wouldn't *have* end-users.

But the real world does.

And the more difficult, picky, and fickle they get about how their screens look and function, the more likely it is you're going to want to change careers.

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In fact, there's almost nothing you *can't* do, because Vermont Views is backed by an incredible library of 586 tested, debugged, reliable functions. Which means that every screen you create can look and run distinctively, uniquely, and precisely the way you need it to.

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Which isn't to say that Vermont Views' portable interfaces are restricted in capability. Anything but! Our DOS interfaces have *everything* that *anyone* has imagined — including full mouse support. And our terminal versions have the fastest screen updates in the business. How fast? Don't bother reaching for the Twinkies. *That's* how fast.

Now take that blinding execution speed, that fourth generation language convience, that power and flexibility, and top it all with great documentation, superb tech support, seven years of developer input... and immediately, one fundamental question leaps to mind: Why are you still letting your end-users whack your fragile head against their hard, heartless walls?

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The new T3300SL

maybe you should get into politics.

If your need for power is on the scale of say, Napoleon, consider the new T3300SL. It offers a 25MHz 386SL microprocessor plus 64 KB cache for blazing speed and longer battery life. Not to mention an 80 or 120MB drive and a PCMCIA-compatible slot. And like its cousin the T2200SX, it offers a Nickel Hydride battery and a carbon-fiber reinforced case. So call 1-800-457-7777. Or if you want even more power, don't forget it's an election year.

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applications do quite well on a 4-MB machine.

And what about clone support? I don't have an official list from IBM, but an unofficial one is available on BIX (see the file CLONES.ZIP in ibm.os2/listings). Among the 386/486 systems that have successfully run both OS/2 1.x and 2.0 are those made by Northgate, Gateway, Everex, Compaq, CompuAdd, Dell, Tristar, Cheetah, Arche, Ergo, Acer, Hewlett-Packard, and Zeos. These systems sport hard disk subsystems with RLL, ESDI, and IDE interfaces (yes, SCSI support is still weak); BIOSes from AMI, Award, Compaq, and Phoenix; display adapters by Video Seven, ATI, Boca, Paradise, and Trident. Yes, high-resolution/deep-color drivers are few. But most observers have been pleasantly surprised by 2.0's promiscuity.—Jon Udell

No Longer Unthinkable

Dick Fleming's "Think About the Unthinkable" (November 1991) was right on the money. I work in an office where we are going through computer-literacy growing pains. Most of our people use computers only because they have to, and they tend to put in only the minimal amount of time to learn about them. I often get on a soap box about backing up files and documenting activities and procedures.

I would add to Fleming's list a screen dump of the system setup menus. Ours got changed by some unwitting soul, and because we didn't have a copy, we had to call the manufacturer for the hard disk data values.

Fleming says that if you take the time to think about the unthinkable, "someone may be grateful that you did." Well, if *you* have a hard disk failure and have to rebuild your system, *you* might be the one who'll appreciate the data recovery notebook that Fleming advocates.

Jerry E. Semler
Huber Heights, OH

Evaluating Standards

Eric S. Raymond's "Standards Everywhere" (January) raises some important issues associated with the increasing growth of "open" standards and economic and technical cartels. Unfortunately, some of his arguments and conclusions are poor at best.

In an attempt to describe the proliferation of standards, he cites "ACE versus SPARC versus EISA versus PS/2. X Window System versus News versus Display PostScript. And GUIs. Don't even *talk* to me about GUIs." These comparisons are incorrect because they do not represent entities of the same class: ACE is a cartel; SPARC is a RISC definition; EISA is a bus standard; and PS/2 is a brand of IBM PC. A better comparison might be ACE versus Sun (or SPARC, Inc.) versus Apple/IBM versus 88/Open. The X Window System is a drawing engine and a crude GUI even without Motif or Open Look—so he has broken his rule about not talking about GUIs. Network Extensible Windows System (News) is display PostScript; News is an example of a failed standard, as Sun is one of the last to support it.

Open standards come from various beginnings, but most are seeded by an economic need to reduce the rate of change for the item being standardized. This is an attempt to reduce software life-cycle costs. Today most new hardware systems have a half-life of 18 months, yet the government and some large businesses can't get the specifications for new software out in less than 12 months. Coupled with an economic need for 10- to 20-year life cycles (with technology infusion every so often), the computer industry is becoming very strained.

Standards slow the rate of change, allowing users to keep up to date with technology without massive costs. Major standards do tend to take longer to be approved or to change than one would like to see, but standards force industry to serve users, not sellers.

I agree with Raymond that any standard with more exceptions than rules should be shunned. I do not agree with his Rules for Standards Survival. Rule 1 states that you should wait to commit to a standard until everyone else also appears to commit. If you do that, you are likely to be left out in the cold. Rule 2 warns you not to honor a standard if it's dictated by a single entity. This is true in most cases; however, if the government is that entity, you may be right only half the time. Rule 3 states that the bigger the standard, the less its value. For an example of why this is wrong, look at Ada. It's a small standard, yet it lacks the elegance that Raymond says he values.

Larry Chandler
Eagan, MN

Humans vs. Machines

I enjoyed Ben Smith's "The Dangers of Multitasking" (December 1991). However, with the greatest respect, I suggest that he has got the hierarchy of computers and humans upside down.

To my mind, the core of human communications is the dynamic modeling of all the other participants and then the recursive modeling of oneself, and everyone else, within that model, all updated in milliseconds at critical points in a discussion. This is an exquisitely intricate affair, involving as it does the feelings and relationships of those involved, over and above the technical matters under discussion.

The issue has wider importance when viewed from a sociological point of view. Just as Smith fears, I believe that our technical tools imperil our society by trivializing our behavior.

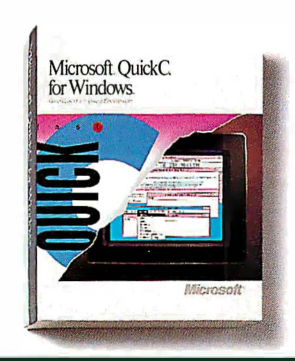
Suffice it to say, I am impressed that these aspects of technology are getting exposure in such a technically oriented journal. Keep up the good work!

Duncan M. Butlin
Tulsa, OK

FIXES

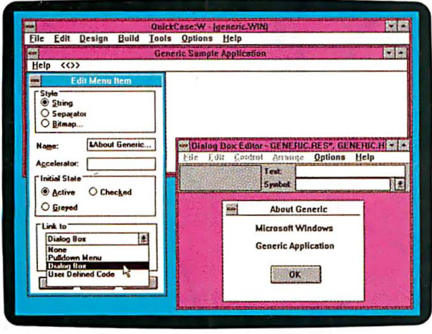


- In the February First Impressions (pages 39 and 47), we neglected to swap three high-resolution images for low-res. We apologize to Farallon Computing, Inc., and Microsoft Corp.
- The GXtra/W SBus card from Tech-Source (February, What's New, page 54) comes with a keyboard and a mouse port, not a keyboard and a mouse. ■

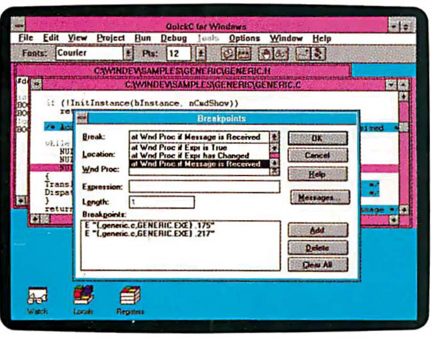




Graphic proof that developing Windows apps is now easier.



Use QuickCase:W to draw the graphical elements of your Windows program, from menus and dialog boxes to cursors and icons. Then, let QuickCase:W generate commented expert-level C source code for the design that you've created.



QuickC for Windows supports a wide range of breakpoint types, from breaking at a location to breaking on a Windows procedure when a message is received.

Take a look at Microsoft® QuickC® for Windows™.

It's Windows-hosted, so you can edit, compile, and debug inside a single environment. Click on the Toolbar™ to choose frequently-used functions, from changing fonts to setting breakpoints. Workspace templates let you save your screen layouts, so you can reload them quickly from another session.

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- Windows-hosted integrated development environment including an editor, compiler, and debugger.
- All you need to write a Windows-based program.
- QuickCase:W generates source code from your program design and regenerates the code if you change the design.
- Wide range of breakpoint support, including breaking at a location, breaking when an expression has changed, and breaking at a Windows procedure when a message is received.
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- QuickWin library for converting well-behaved C programs for DOS to Windows programs.
- Generates Windows Executables, Windows Dynamic Link Libraries, QuickWin Executables for the Windows environment, and MS-DOS® Executables.

PROGRAMMER'S TIPS

- *To rebuild your character-based DOS applications to run under the Windows environment, select the "QuickWin EXE" Project type in the Options menu.*
- *Use the new and improved Dialog Editor to quickly and easily design dialog boxes for your programs.*



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The Pros Rate CA-SuperCalc Higher Than Lotus 1-2-3 And Microsoft Excel.

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Ability to manipulate data	7.31	6.71	7.00
Sorting capabilities	7.50	6.64	6.68
Provision for software security	6.96	5.25	5.10
Report writing capabilities	6.78	5.33	6.17
Ease of use of interface	7.45	6.19	6.77
Software integration capabilities	7.30	6.23	6.78
Ease of data retrieval	7.50	6.78	7.00
Satisfaction with product profitability	6.81	5.75	6.42
Overall quality of product	7.70	7.18	7.53
Provision for customer support	7.52	5.79	6.22
Charges for training time	6.43	5.60	5.71
Provision for technical support	7.34	5.55	5.95
Provision for marketing support	6.69	5.71	5.93
Documentation & product information	6.90	6.70	6.98
Frequency of updates & revisions	6.59	5.75	6.15
OVERALL AVERAGE	7.09	6.05	6.44

Recently, *VARBUSINESS* conducted a survey of some people who know more about spreadsheets than anyone.

The people who sell, install, and support them for a living. The survey asked hundreds of spreadsheet dealers and resellers all kinds of questions to find out what the pros rate as the best spreadsheet. And the pros told them.

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Next to Step into the 486 Arena

Kicking off the first NextWorld Expo in San Francisco, Steve Jobs, president and CEO of Next, confirmed the long-standing rumor that Next will supply its NextStep interface and software development environment on the Intel 486 platform. The entire operating system—the same Mach version of Unix used on the Next platform—will be ported.

Rumors circulated at the show that Jobs would announce licensing deals with Compaq and Dell, but Jobs would only say that Next is negotiating licensing agreements with several manufacturers. Nevertheless, Next demonstrated alpha versions of NextStep 3.0 running on both Dell and Compaq 486 machines during Jobs's presentation and on the show floor. Jobs emphasized that the Intel port in no way affects the company's intent to compete in the hardware marketplace.

NextStep for the 486 will be available in a shrink-wrapped version directly from Next, with an end-user version priced at $995 and a full developer's version priced at $2495. Both versions are essentially identical to their Next computer counterparts. Jobs said that a beta version of NextStep for the 486 will be ready in the second quarter of this year and that a production version will ship in the third quarter.

Jobs claimed that NextStep is catching on in corporate U.S., Japan, and Europe as the premier tool for custom software development, particularly for "in-house, mission-critical custom applications." Jobs said NextStep's object-oriented development environment, Display PostScript imaging model and graphical interface, and Mach multitasking Unix kernel are technically superior to any of the competition's.

"We're three to five years ahead of Solaris, Windows NT, and Taligent," boasted Jobs. Jobs claimed that Next is getting more opportunities to compete with Sun Microsystems for volume sales deals and is "winning 80 percent [of them]."

The problem is that NextStep's advantages are not readily apparent to end users. While software developers find NextStep attractive, they are reluctant to invest in it unless they can see a large installed base of users. Whether NextStep on the 486 can turn things around remains to be seen.

—Nicholas Baran

Quorum Converts Mac to RISC, Provides Latitude over PowerPC

Quorum Software Systems (Menlo Park, CA) is developing a software porting system that helps developers turn Mac System 7.0 programs into native implementations on SPARC, IBM RISC System/6000, and Silicon Graphics Iris Indigo RISC workstations. Quorum's Latitude system maps Mac system and user-interface calls to the native calls of the target platform. The porting system, slated for release in June, lets developers reach an unprecedented number of platforms with a single instance of source code.

Silicon Graphics and SunSoft officials expressed delight at seeing Mac applications migrating to their platforms. But Latitude provoked quite a different attitude from at least one Apple official. Roger Heinen, vice president and general manager of Apple's Macintosh Software Architecture Division, sat quietly in the audience as he watched Latitude's unveiling at the UniForum trade show and said only that he could not comment.

Quorum's product was previewed at the MacWorld Expo. At that show, Mac software was shown running blazingly fast on an Indigo workstation.

One possible reason for Heinen's muted response is that Apple may have entered into its alliance with IBM mainly in the hope of seeing the Mac integrated into the RISC world on the PowerPC. Quorum Latitude appears to do now what the PowerPC will do in 1993 or 1994.

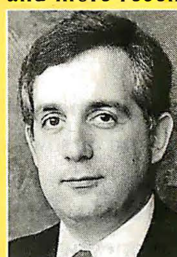
—Ellen Ullman

NANOBYTES

Canon plans to distribute a kanji version of **NextStep 3.0** in Japan. Reports in the Japanese press also indicate that Canon will port a Japanese version of NextStep for the 486 to its 32-bit PCs. □

A major revision to the NextStep interface and development environment is scheduled to ship in June. In the networking arena, NextStep 3.0 will include built-in Novell NetWare and AppleShare protocols, which will allow seamless networking to PCs and Macs and to Unix workstations that support NetWare. Version 3.0 will include support for PostScript Level 2 and the **RenderMan 3-D** development specification. NextStep 3.0 also includes two long-awaited features: object linking and a database toolkit. □

In the keynote speech of January's Usenix conference, **Mitch Kapor**, founder of Lotus Development and more recently the chairman of On Technology, discussed the commercial access and use of the **Internet** network, which is dedicated to research and educational use. The Internet is becoming increasingly commercial, raising the same types of questions first asked about TV during its infancy, such as who is going to own it and who is going to control it. Before TV became popular, everyone thought that it would be the uplifting factor that would raise our culture from ignorance and apathy. Of course, that's not quite what happened. Kapor pleaded with his listeners not to let the Internet end up like the "vast wasteland of TV." □



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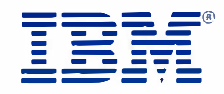
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MICROBYTES

Rambus's New Memory Architecture Could Put More Video PCs on Desktops

Rambus, a start-up company backed by three venture-capital firms and stocked with a stable of technical engineers, has developed a DRAM architecture and chip-to-chip data transfer technology that could solve the classic memory bottleneck problem. Geoff Tate, president and CEO of the Mountain View, California, company, said that the Rambus interface standard can be directly implemented on CMOS DRAMs, memory controllers, processors, graphics/video chips, and other components.

Tate said that Rambus's solution will deliver a tenfold increase in component throughput. A single Rambus DRAM (RDRAM) delivers up to "500 million bytes per second on a standard PC over a narrow, high-speed bus," he said. The company expects to capture more than 50 percent of the DRAM market by 1997. Tate adds that the company's solution uses fewer ICs and a modular system.

The problem Rambus addresses is well known to systems designers: The data transfer rate of memory ICs lags behind a processor's ability to handle data. Although DRAM densities have increased, DRAM performance has improved only marginally. Because of this, systems designers have resorted to complex workarounds of the bottleneck by using multilevel memory hierarchies, with Level 2 static RAM (SRAM) caches and cache controllers. And as display resolutions increase and customers clamor for true color, costs are driven up due to the memory needed to supply pixels at a high rate for a flicker-free display. Animation graphics and video also require high data transfer rates to display images in real time. All these requirements have resulted in complex architectures that use specialized multiport DRAMs or video RAMs (VRAMs) to maintain the high data transfer rates.

Rambus replaces all these subsystems with a solution made up of masters, slaves, and a narrow, high-speed bus. Rambus engineers have developed a bus that's 1 byte (9 bits) wide and capable of transferring data at 500 MBps by using both edges of a 250-MHz clock. Masters and slaves connect to the printed-circuit board via a simple 32-pin interface. Small signal swings replace conventional, noisy TTL signals and operate in a controlled-impedance transmission-line environment, the company says.

Rambus says that its design will eliminate the need for Level 2 SRAM caches, cache controllers, and today's VRAM. Toshiba, Fujitsu, and NEC have already agreed to become Rambus interface licensees.

Tate predicts that RDRAMs will enable designers to jump from 8-bit VGA 256-color palettes to low-cost 24-bit true-color graphics. But he admits that there are still barriers to the Rambus vision. "You're not going to do animated graphics on today's monochrome displays." Nevertheless, Rambus may provide a solution that will accelerate the progression toward true video PCs.

—D. L. Andrews

BSDI: Unixlike and Free of AT&T

To a cheering audience of 1000 Usenix conference attendees, former SunSoft employee Rob Kolstad announced his new company, BSDI (Falls Church, VA), and its new product, a Berkeley Unix–compatible operating system for 386 and 486 PCs. The Unixlike software, called BSD/386, is 100 percent free of AT&T code and licenses, which means it costs less: Including the kernel and full source code, it sells for $995. A binary-only (i.e., non-source code) version should be available in the third quarter of this year for $500.

BSD/386 is a complete operating system that is compatible with BSD 4.3 with BSD 4.2 networking. It includes TCP/IP, X Window System 11.5, Posix functions, ANSI C, C++, `troff`, Tex, and a reimplementation of Sun's Network File System. It supports more than a dozen popular Super VGA cards, most mice, and SCSI, IDE, and ESDI controllers. To use it, you'll need a 386 or higher PC with 4 MB of RAM and a 100-MB hard drive. By the third quarter, BSD/386 will be able to run all SCO Unix applications without a hitch, BSDI says.

The product is the result of years of effort by the Unix community to create a widely available, AT&T-code-free Unix workalike. The crowd responded to Kolstad's presentation with great enthusiasm, applauding and cheering each member of his team.

—Ben Smith

NANOBYTES

It wasn't quite the same as Dire Straits front man Mark Knopfler singing about moving refrigerators



and color TVs, but as BSDI program manager **Rob Kolstad** explained all the various licensing options of his company's Unixlike BSD/386 software, he said with his usual wit, "I'm Crazy Rob. I've gotta move these kernels." ☐

At Buscon/92-West in Long Beach, California, IBM showed a technology demonstration of streaming data approaching a **160-MBps data transfer peak**. The demonstration used a modified RISC System/6000 deskside unit and a bus-master adapter card on the Micro Channel bus, both developed specifically for the demonstration. ☐

At UniForum, DEC announced version 1.0 of **DEC OSF/1**, what the company calls the "first production version" of the Open Software Foundation operating system. Users can't install this system, which is a developer's version, scheduled to ship last month. The end-user platform will be version 2.0, due in the second half of the year. ☐

At the recent National Association of Music Merchants International Music Market show, Passport Designs (Half Moon Bay, CA) announced a preliminary version of Producer, which the company calls "integrated digital audio and MIDI soundtrack software." The software, the first version of which will run on the Mac, will integrate computer animation, graphics, titling, laser discs, video, CD-ROM, MIDI, samplers, sound cards, and soundtrack software. The company also plans a Windows version. Passport says that the main use of Producer is as a media integration tool, accepting inputs from many sources and letting you build a final product. ☐

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Autodesk, *Robert Wenig, Manager, AutoCAD for Windows:* "At Autodesk, we're using WATCOM C/386 in the development of strategic new products since it gives us a competitive edge through early access to new technologies. We also highly recommend WATCOM C/386 to third party AutoCAD add-on (ADS and ADI) developers."

Fox Software, *David Fulton, President:* "FoxPro 2.0 itself is written in WATCOM C, and takes advantage of its many superior features. Optimizing for either speed or compactness is not uncommon, but to accomplish both was quite remarkable."

GO, *Robert Carr, Vice President of Software:* "After looking at the 32-bit Intel 80x86 tools available in the industry, WATCOM C was the best choice. Key factors in our decision were performance, functionality, reliability and technical support."

IBM, *John Soyring, Director of OS/2 Software Developer Programs:* "IBM and WATCOM are working together closely to integrate these compilers with the OS/2 2.0 Programmer's Workbench."

Lotus, *David Reed, Chief Scientist and Vice President, Pen-Based Applications:* "In new product development we're working with WATCOM C because of superior code optimization, responsive support, and timely delivery of technologies important to us like p-code and support for GO Corp's. PenPoint."

Novell, *Nancy Woodward, V.P. and G.M., Development Products:* "We searched the industry for the best 386 C compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."













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Spreadsheet Could Boost PenPoint

At-Hand, a spreadsheet developed for Go Corp.'s PenPoint operating system for pen-based computers, could be the first application to validate the PenPoint platform. Developed under the direction of Dan Bricklin, vice president of development for Slate (Scottsdale, AZ), the program fully exploits the advantages of pen computing.

Bricklin gave this reporter a preview of At-Hand running on a prototype pen-based machine from Samsung. Instead of using a traditional spreadsheet's edit line to enter labels and values, you just write directly into cells using the stylus. At-Hand offers a 256- by 8192-cell grid, immediate access to 90 built-in functions, and 15 types of charts and graphs. Bricklin described the language as "BASIC-like...but it knows about spreadsheet primitives such as cells and ranges."

At-Hand reads and writes WK1 (Lotus 1-2-3) and XLS (Excel) files. In a typical scenario, Bricklin says, users will transfer files to and from their pen and desktop systems. When At-Hand files are sent to the desktop, the program provides a choice of export formats. Of course, it supports PenPoint's standard gestures and connectivity and recognizes handwriting, with optional deferred recognition. It also incorporates an extensible graphics language that lets corporate developers improve the spreadsheet's graphing capability by creating specialized graph types.

The software uses 1.5 MB of hard disk space and requires only about 500 KB of RAM to run. Although it is scheduled to ship in the second quarter of this year at a list price of $295, At-Hand product manager Lisa Underkoffler cautions that the schedule is dependent on Go's releasing PenPoint.

—D. L. Andrews

RFI Problems Plague Pen Systems

Massive increases in RFI from pen-based computers are causing the FCC to rethink its testing procedures; it has already delayed the release of at least one pen-based system. The RFI problem doesn't pose a health threat to users, but it does mean that some of the eagerly awaited pen-based designs will be later to market than expected because of redesigns.

The problem is that when you place your hand close to the screen of an operating pen-based computer, the RFI the computer produces increases enormously. Since all pen-based systems involve writing on the screen with a stylus, that increase occurs with normal use of the system.

Charles N. Cobbs, chief of the FCC's equipment and authorization branch (Columbia, MD), says that the emissions increase can be as much as 15 dB. "This is not like tripping over a curb, it's like falling over a cliff," Cobbs says. "We couldn't let that go."

Essentially, the human body serves as an antenna to radiate additional energy from the computer. The radiation is not dangerous to people, but it is enough to interfere with electronic equipment.

The problem was unexpected because the FCC's current test standards don't allow for a user's effect on the system RFI. As a result, the manufacturers weren't looking for those effects in their designs. The first company to get caught with this problem was NCR and its 3125 pen system.

—Rick Cook

Apple and Sharp May Be Paired Up in the Consumer Market

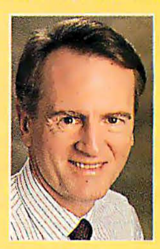
Now that Apple chairman and CEO John Sculley has said that Apple will enter the consumer electronics market, observers have wondered what products the company will offer. Sculley told attendees at the semiannual Consumer Electronics Show that Apple will enter the "digital consumer information products sector of the consumer electronics industry" and reiterated Apple's interest in the technology of Personal Digital Assistants.

Sculley also said that Apple has worked this year to establish relationships with several leading consumer-electronics companies. Sony may be the company that comes to mind as first choice for a partnership, but sources say that Apple will work with Sharp on CD-based devices, which may already be built. Longtime Apple partner Frogdesign may also have had a hand in the devices' design.

—Larry Loeb

NANOBYTES

When you see this man's face, think of QuickTime. In his keynote address at the MacWorld Expo show, Apple chairman and CEO **John Sculley** said that what people would remember the most about his time at Apple is QuickTime—even more than the Macintosh. □



It's also now clear that Apple thinks QuickTime will influence platforms other than the Mac. At the show, Apple announced plans to bring the benefits of QuickTime to other computing environments such as DOS, Silicon Graphics, DEC, and Cray Research. To further extend the adoption of Apple's Movie file format, **Corel Systems** is developing a file format translator to be shipped with the QuickTime Starter Kit, a product for those who want to explore the capabilities of QuickTime. The Corel utility will allow the conversion of popular DOS and Windows format presentations, graphics, and animation files into QuickTime movies. Apple wants QuickTime to be the cross-platform method for personal computers to handle multimedia. □

At NetWorld, CE Software announced QuickMail for MHS (Message Handling Services), which the company says will provide Novell network users with "similar functionality and flexibility" to the QuickMail product for the Mac. Previous versions of QuickMail supported Macs and PCs, but they required both a Mac server and an AppleShare network. The planned new version will provide **native NetWare MHS** support for the Macintosh. □

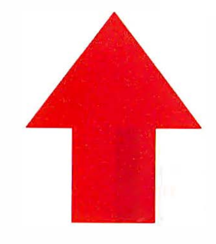
Apple is reportedly working on new technology that lets people control off-the-shelf Macs using ordinary spoken language. The technology may be used in future consumer products. □

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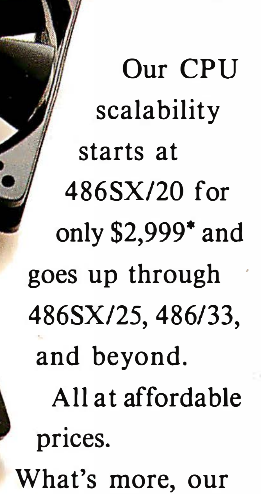
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Microsoft and Intel Team Up on Portable Power

Until computer hardware gets less energy-hungry, the only way to cut power use in portable machines will be through better software tricks. Microsoft and Intel have now created a suite of technologies, called the Portable Computing Initiative, that are intended to do just that. By matching operating-system features with the special hardware of portables, the two companies aim to improve the efficiency of mobile computing.

The Portable Computing Initiative encompasses several efforts, including putting system software in ROM instead of on disk, developing drivers for PCMCIA solid-state storage cards, and building a simple data transfer utility into DOS.

The most innovative development is called Advanced Power Management (APM), which gives applications the ability to tell the hardware when it doesn't need certain system resources, such as I/O ports; this will let programs help the system save energy. Most power management today is performed only at the system level, without regard to program state.

According to Microsoft, Windows and many applications are idle 50 percent to 75 percent of the time, waiting for user input or other system events. By providing an application programming interface (API) through which compliant programs can write to the system BIOS and say that they are idle, you can cut power usage by as much as 25 percent, Microsoft says. Not only can the system be intelligently shut down, but it can also select peripherals or add-ins. The APM scheme is defined independently of the CPU, chip set, and operating system.

Why use an API instead of building these features directly into the operating system? Unlike in the Mac world, where virtually all software interacts with the system through defined system calls, many DOS programs bypass the operating system and interact directly with firmware.

—Owen Linderholm

Headland's Cache Enhancement Chip Set Optimizes the 486

Headland Technology (Fremont, CA) has introduced a chip set with cache-enhancement features that optimizes the performance of the 486 processor's internal cache. The company says that the benefit of the HTK340 chip set is that the processor never has to wait for write operations, resulting in improved system performance.

As Headland describes it, the significant performance determinate, on the system level, of the 486 is efficiency in memory write operations. Headland says its advanced features eliminate the write bottleneck by integrating a four-level-deep write buffer with out-of-order operations and byte gathering. The company tries to eliminate the DRAM write bottleneck by assembling 8- and 16-bit writes and writing them as 32-bit writes, and by allowing out-of-order operations while maintaining the integrity of the data.

Headland claims a twofold to fourfold improvement in DRAM write operation efficiency. Like the first member of this family, the HTK320 386DX chip set, the HTK340 is a two-chip set that includes an ISA bus controller chip and a memory controller unit. A Headland product line manager admitted that the improvement offered by the chip set isn't all that evident with low-level benchmarks. It shows up more on "complex, real-world" benchmarks.

The chip set supports frequencies of up to 33 MHz. It will cost $45 each in quantities of 1000.

—Ken Sheldon

C&T Quits Multiprocessor Business

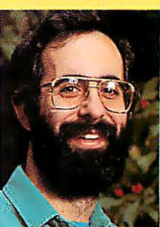
Chips & Technologies is pulling out of the multiprocessing chip-set business. Saying the market is too small, the company has announced that it will try to sell off its M/PAX architecture and technology, which can tie together as many as six 386 or 486 processors in a LAN server. C&T was the only company left trying to make money as a merchant supplier of multiprocessing chip sets. Most multiprocessing servers, such as the Systempro from Compaq, use proprietary designs. ■

—Rick Cook

NANOBYTES

To reduce use of the power-hungry hard drive, Microsoft has developed a ROM-based version of DOS 5.0, and it's now shipping. The company also says it has created scalable versions of DOS 5.0 that take up less RAM in exchange for reduced functionality. One tiny 4-KB version of COMMAND.COM lets a system run DOS programs but not perform any other functions. This will be especially useful for palmtops with limited memory and that only need to launch programs. □

Slate vice president Dan Bricklin predicts that in two years some pen-based computers will retail for under $1000. The same systems today can cost as much as $5000, if you can find one. Bricklin said that pen-based systems running PenPoint are currently **"scarcer than hens' teeth."** After a pause, he added, "Actually, there are a lot more hens' teeth in the world." □



Specular International (Amherst, MA) is working on a tool for reducing the time required for rendering graphics images. A new program called **BackBurner** lets you render a single image on multiple Macs by dispersing rendering tasks over Ethernet or AppleTalk networks and relegating the most intensive rendering duties to the fastest available machines. BackBurner must be used with Infini-D, Specular's 3-D rendering, modeling, and animation software. Pricing has not been determined. □

The great baseball player Satchel Paige once said, "Don't look back—something may be gaining on you." Intel must feel that way sometimes about AMD. **AMD** is developing a 486 and a 33-MHz version of the Am386SX, which will be manufactured with an advanced 0.7-micron CMOS process that allows low power operation. ■

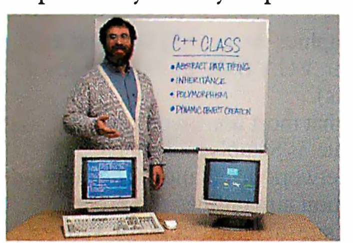
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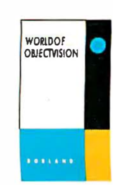
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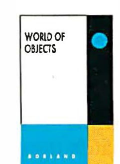
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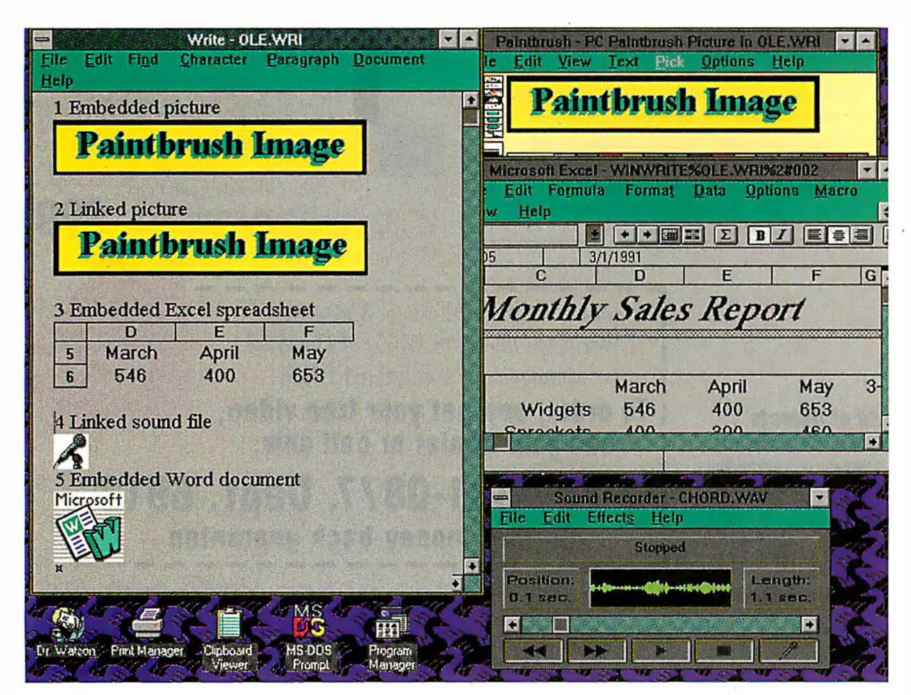
Windows 3.1 Is Ready to Roll

JON UDELL

After a long gestation period, Windows 3.1 has matured into a solid product that fixes past problems and introduces mainstream PC users to multimedia

Scalable fonts, compound documents, and multimedia support are headline attractions, but the Windows 3.1 story doesn't end there. A great many fixes and refinements—none revolutionary—conspire to make version 3.1 a faster, friendlier, and stabler system. You'll notice improvements as soon as you launch Setup. Following an optional tutorial, you can take the "express" or "custom" route. Choose the latter, and you specify the games, wallpaper, and accessories you want and skip the rest. (The multimedia subsystem is not optional, however.)

You'll notice longer lists of supported display adapters, printers, and networks. The standard display drivers now include Texas Instruments Graphics Architecture, Extended Graphics Array, 8514/A, and a generic Super VGA (800 by 600 pixels with 16 colors).



Objects embedded in or linked to a Write document launch their creators when you double-click on them. It looks easy, but you may be surprised at what happens when you save, copy, or print the document. OLE breaks important new ground but raises thorny user-interface issues.

Something that most users won't see, but that I appreciate, is Setup's more intelligent handling of network installation. The new Setup /A option streamlines the process of loading a site-licensed copy of Windows onto a network drive and marking the files read-only. Tweak a few lines in a Setup file, and you can present users with shared Program Manager groups containing only the applications you want them to run, while crippling Program Manager's ability to launch unauthorized software or to create new groups and items.

Serious network administrators still have plenty of reasons to lean on advanced utilities like Windows Workstation from Automated Design Systems. But those who rightly complained about LAN installation of Windows 3.0 will find version 3.1 more cooperative.

Printing with TrueType

TrueType isn't just an Adobe Type Manager clone. On your screen, the two technologies produce similar results—fonts that scale cleanly. But TrueType's superb printer support transcends what ATM offers. If you have a Hewlett-Packard LaserJet Series II and you don't have HP soft fonts, or don't have them installed properly, ATM can create pages that match what you see on-screen only by cranking out huge bit maps that clog your network and take forever to print. TrueType, on the other hand, conjures up the downloadable fonts on the fly. It's fast, convenient, and utterly transparent.

The same technique works with PostScript printers: TrueType can manufacture unhinted Adobe Type 1 fonts on the fly. If you inspect the PostScript code that's generated, you'll see that the driver cleverly defines only the characters actually used in the print job. You can also send bit maps, or, if you know that the printer has an Adobe font whose metrics match those of a TrueType font, you can just invoke the printer fonts directly.

Choose Your Mode

Windows 3.1 abandons the vestigial real mode. Users won't mourn its passing—version 3.0 would run on an 8086, but not happily—and programmers will breathe a collective sigh of relief. That leaves standard mode for 286 and low-end 386 machines and enhanced mode for 386/486

It Talks, It Sings, It's Multimedia Windows

Tom Yager

Windows 3.1 seems like much more than a point release. But one crucial piece of it—multimedia support—hit the streets several months before its commercial release. The Windows Multimedia Extensions are part of the Multimedia PC specification (see "The Multimedia PC: High-Powered Sight and Sound on Your Desk," February BYTE). With version 3.1, the software side of MPC becomes a standard part of Windows.

What the extensions buy you depends largely on your configuration. The most accessible addition is audio. If you have an audio I/O card like Creative Labs' Sound Blaster Pro, the new routines and applications in version 3.1 will let you record and play digitized sound. If your audio card supports MIDI, or you have a component MIDI device that's compatible with Roland's MPU-401, version 3.1 will let you record and play MIDI data. The Multimedia Extensions are, not surprisingly, extensible, so in addition to audio and MIDI, they support the following media types: CD audio, videodisc, video overlay, and animation. Each of these types (except animation) requires additional hardware and, in most cases, drivers supplied by vendors.

In a way, animation requires additional hardware, too: a Mac, which is now the only way to create an MPC-compatible animation. Support for full-motion (digital) video (using the "digitalvideo" media type) is expected shortly, and there are also reserved (but not supported) media types called dat, scanner, vcr, and other. I don't know what an "other" does, but the rest of the names are self-explanatory.

Some of the media types are covered by their own low-level programming calls. For some operations, such as MIDI recording, it helps to have the most direct control possible. But the heart of the multimedia programming support is the Media Control Interface. This is a well thought-out, high-level function-call interface to a command interpreter. An MCI command string includes a command, a target device, and arguments. The interpreter routes the command to the appropriate handler for the specified device.

The result is readable code and straightforward addition of new media types to existing applications. The string interface also works well with alternative Windows programming environments like ToolBook. Those of us who work in C need Microsoft's Multimedia Development Kit, which requires a CD-ROM drive and the Windows Software Development Kit.

MCI's command structure is patterned after a tape transport. Commands supported by most devices include open, play, and pause. The first two are all that's required to get most media types to play or display their output. Here is one that plays a digital audio file called WILLIAM.WAV:

```
open \sounds\william.wav
type waveaudio alias bill
play bill
```

The alias simply gives you an easier way to reference the open file. Playing a MIDI file, an animation, a track on an audio CD, or any of the other supported media types is no more difficult than this, and digital video and other future types will follow the same command format.

If you're not a programmer, the fact that MCI is so easy to write helps you as well. MPC-compatible software will become available rapidly because MCI is such a cinch to learn and use. Microsoft probably hopes you'll see all the multimedia stuff in version 3.1 and run out and buy an MPC upgrade kit. Maybe that's not such a bad idea.

Tom Yager is a BYTE technical editor and director of the Multimedia Lab. He can be contacted on BIX as "tyager."

workstations with 2 MB or more. Version 3.1 will run in standard mode in the presence of DOS 5.0's EMM386 memory manager, something that version 3.0 refused to do. But users who have favored standard mode even on high-end hardware might want to reconsider that policy in light of version 3.1's enhanced mode.

The virtual memory manager has been overhauled, and disk I/O benefits from a new 32-bit virtual device driver that works with Western Digital and compatible hard drive controllers. A performance boost, not mode-dependent, comes from the new Smartdrive. Caching both reads and writes, it keeps my disk noticeably quieter than its version 3.0 counterpart.

Keep on Keeping On

As a DOS multitasker, version 3.0's reach often exceeded its grasp—it encouraged you to try things that either wouldn't work or wouldn't work reliably. This wasn't surprising, given the sandy DOS foundation on which Windows builds its airy superstructure of virtual machines (VMs).

What has pleasantly surprised me about version 3.1 is that, although the basic architecture hasn't really changed, DOS multitasking does work a whole lot better. Preliminary CPU and screen I/O benchmarks peg version 3.1 VMs well ahead of their version 3.0 counterparts. And the VMs are much more stable. Incidentally, version 3.1 can handle 9600-bps serial communications, even in the background.

Matching some of OS/2 2.0's features, windowed VMs now provide DOS mouse support and offer a variety of alternative fonts. An .INI file remembers the size and location of windowed DOS programs.

Windows now traps the three-fingered salute. Press Ctrl-Alt-Del, and version 3.1 prompts you to continue the current DOS (or Windows) task, kill it, or actually reboot. If you pull the plug on a DOS task in this situation, Windows shuts it down without the scary termination message.

According to Microsoft, Windows does a sanity check to see if DOS seems healthy. Even so, a rogue DOS task can subtly alter low memory and bring down the whole

system. Does that matter? In practice, it may not. I think many users just want Windows to run their important DOS programs "well enough," and version 3.1 meets that criterion better than version 3.0 did.

If a Windows task meets with misfortune—at your hands or in the form of what used to be called an unrecoverable applications error—you're in better shape than before. Windows again performs a sanity check, this time on its own data structures, and, according to Microsoft, it can even repair damage so the system can continue safely.

Additional lines of defense include stricter parameter checking (both at run time and in the Windows header file), more informative error messages when protection faults do occur, and a postmortem utility (Dr. Watson) that records Windows' state and the user's description of the actions leading to the fault.

Given that Windows and its tasks still share one local descriptor table in version 3.1, protected mode isn't as bulletproof as in Unix or OS/2. But the pragmatic approach that Microsoft has taken—managing faults both proactively and reactively—should help matters a lot.

On the Applications Front

Most Windows 3.0 applications I tried ran happily under version 3.1, including PageMaker, CorelDraw, Picture Publisher, Persuasion, Turbo Pascal for Windows, Word for Windows, and Excel. As you'd expect, I ran into some programs that will require maintenance upgrades, including PowerBuilder, Quest, and WinSleuth Professional. In general, however, your transition shouldn't be traumatic.

Old chestnuts like File Manager, Write, and Paintbrush improve in a variety of ways. For starters, they now exploit common dialog boxes for opening and saving files, selecting fonts, and printing. Mac programmers who have used `SFGetFile` and `SFPutFile` for years will find it amusing that Windows is only just now getting into the act. Still, better later than never.

File Manager now presents directory trees in a more useful double-pane format and reads in directories much faster. While it was formerly unusable on large network drives, it has become a handy tool for browsing and disk grooming. File Manager is also the source of version 3.1's new drag-and-drop behavior. You can drag files out of File Manager's window and drop them onto Print Manager, onto iconized applications, or into open application windows. To print in this manner, the document you drop must be associated with an application that must define a print command in the new system registration database.

An even more interesting thing happens when you drop a .BMP file onto an open Write document. Windows thinks for a minute, and a Paintbrush icon appears in the file. When you double-click on it, Paintbrush launches and loads the bit map. You've just used drag-and-drop to embed a reference to one document inside another. Behind the scenes, Windows ran a tool called Packager to specify the embedded object's appearance (the Paintbrush icon) and its content (the reference to the .BMP file). Welcome to the weird, wonderful world of Object Linking and Embedding (OLE).

Everybody Say OLE

The version 3.1 accessories include OLE servers (Paintbrush and SoundEdit) and OLE clients (Write and CardFile). Other applications that formerly rolled their own OLE but can interoperate with the OLE libraries shipped with version 3.1 include Word, Excel, and Ami Pro.

The Write document in the screen contains a series of embedded and linked objects. The two Paintbrush images appear identical, but they aren't. The first, an embedded object, resides anonymously within the Write document. The second, a linked object, takes up the same amount of space in the Write document but refers to a named Paintbrush file. In both cases, double-clicking on the object launches Paintbrush. But the embedded object is accessible only via Write; the linked object can also be reached by loading its corresponding file into Paintbrush.

In addition to the drag-and-drop I've already described, you can embed an object by pulling a file directly into the client using the Insert Object command, or by copying from the server to the Clipboard and then using the client's Paste Special command. To link, you copy from the server to the Clipboard and use either Paste Special or Paste Link in the client.

This all sounds simple, and in a way it is, but it takes a surprisingly long time for all the implications to sink in. The three flavors of Paste command—Paste, Paste Special, and Paste Link—can be confusing, especially since Paste Special usually lists a variety of formats the client can use to render the embedded or linked object. Yet the results of each of these procedures can look exactly the same.

Also, those results may or may not be what you expected. When you paste a range of cells from a spreadsheet into Write, you expect to see something that looks like a spreadsheet—and you do. When you double-click on the sound object, you expect to hear something, and with a sound board installed, you do. But when you paste a range of text from Word, what appears is Word's icon, not text. Why? The OLE client library can render only metafile or bit-map data. Microsoft has defined a way for an OLE server to provide an "object handler" that renders data on its own terms—formatted text, in the case of Word.

OLE in its current form is a bold experiment. It lacks the network awareness of Apple's Publish/Subscribe, begs for a next-generation file system that is itself somehow object-oriented, and often doesn't behave the way you'd expect, but it's a good start. As programmers learn how to use the daunting OLE libraries, I think we'll see Windows software evolve in fascinating new directions. ■

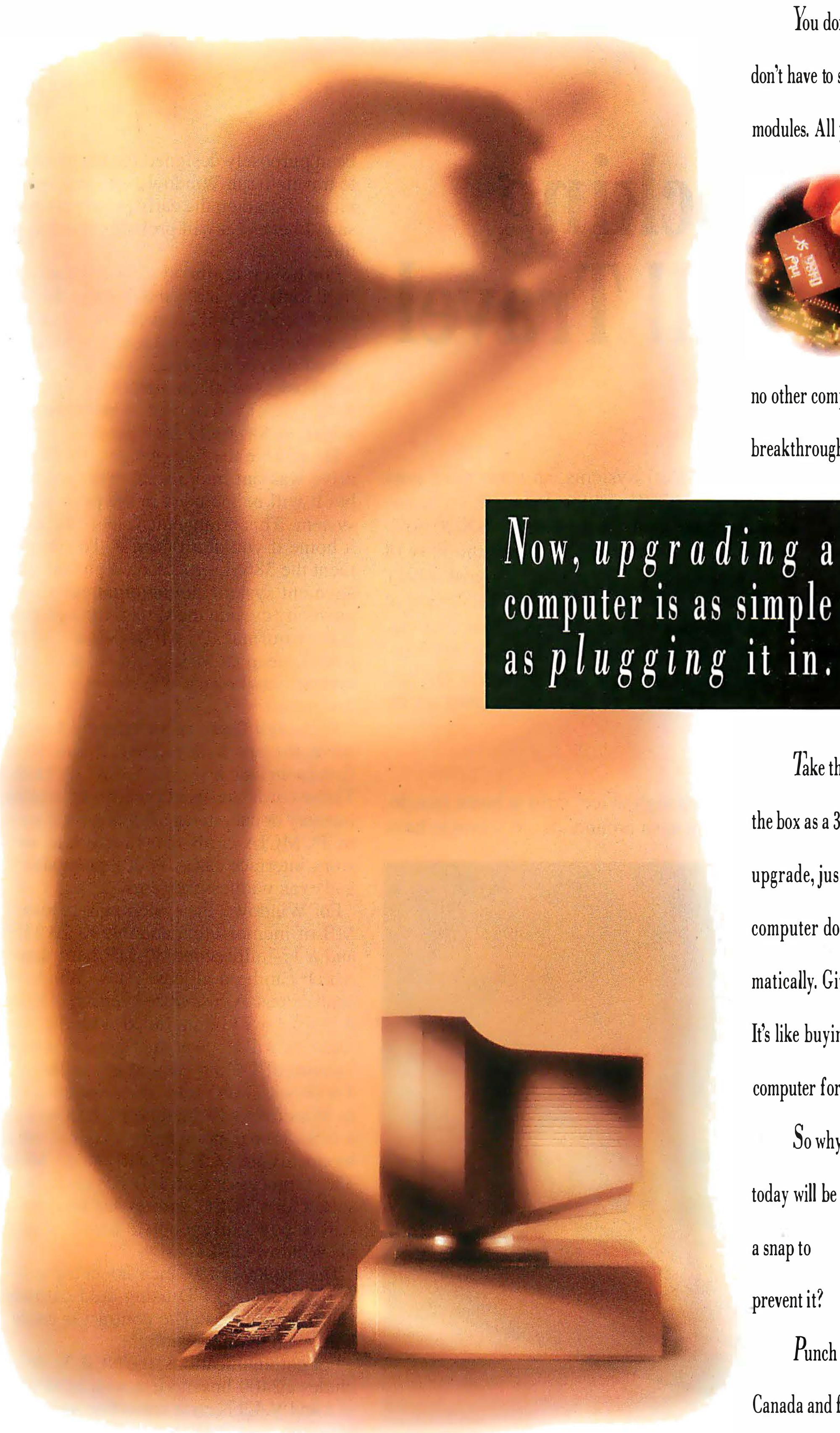
Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

THE FACTS

Windows 3.1
$149; upgrade from Windows 3.0, $49

System requirements:
Standard mode: 286 or higher with 1 MB of RAM, a mouse, and a supported monitor.
Enhanced mode: 386 or higher with 2 MB of RAM, a mouse, and a supported monitor.
Multimedia Extensions: a sound board and/or a CD-ROM drive.

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Have Docking Station, Will Travel

RICH MALLOY

The NCR 3170 Safari Notebook, with its FingerPoint Mouse, signals a new generation of portables

Last year, Safari Systems, an interesting joint venture of AT&T and the Japanese company Marubeni, brought out the Safari NSX/20 notebook (see "IBM and AT&T Enter the Fray of 386SX Notebook Computers," August 1991). That system went on to win a BYTE Award of Merit and quite a bit of attention. This year, Safari Systems has been folded into AT&T's recent acquisition, NCR. The company has just introduced a bold new machine, the NCR 3170 Safari Notebook, which may set the pace for many notebooks to follow.

A Designer Notebook

Like the NSX/20, this new notebook is stylish enough to feel right at home in a designer showroom. But this system wasn't meant to sit around idly. It seems to have been purposely designed for three things: to travel, to run Windows, and to communicate. Based on the early prototype that I saw, I believe it will probably excel at all three.



Photo 1: *The NCR 3170 Safari Notebook is similar in style to the award-winning Safari NSX/20 notebook.*

For traveling, the system is small and light (only 5 pounds) and features the battery-friendly 386SL processor. (You can also save power by manually setting the speed to 6 or 12 MHz.) The size of the notebook is small enough (8 by 11 by 1¼ inches) to let you fit it into a briefcase with a ream of 8½- by 11-inch paper.

To achieve the light weight, the floppy drive was put into a small external box, but it will be included in the price of the system. This arrangement lets you leave it home if you don't need it. To complement the 386SL processor, a power management system can automatically save power by cycling the system through four states: normal (25 MHz), slow (3.125 MHz), sleep (0 MHz), and suspend (the system shuts down and draws only 20 milliamperes).

Although there is no internal floppy drive, the new Safari system is one of the first to include a slot for PCMCIA cards. These cards are used mostly for adding memory or data storage, but there will soon be PCMCIA cards that function as network interface cards, 9600-bps modems, and even wireless modems.

For Windows, the system will feature 2 MB of memory (expandable to 20 MB) and a 17-millisecond 80-MB hard drive, which can hold at least a few Windows applications. A customized version of Windows 3.1 will be included with the machine, as will a power management–aware version of DOS 5.0a and an Asymetrix ToolBook TourGuide. The modifications to Windows will include such things as a large mouse pointer for easy use on a monochrome LCD screen. The 25-MHz 386SL processor with a 64-KB cache (and socket for a 387SL) ensures that the system will be powerful enough to handle almost all Windows tasks easily.

The display is a 9½-inch sidelit triple-supertwist VGA LCD using cold-cathode fluorescent tubes. The contrast is excellent, even in direct sunlight.

For communications, the NCR 3170 includes a 2400-bps modem with MNP level 5 and V.42bis error correction and compression, and 9600-bps send/receive fax capability. Other ports are standard-size connectors for one serial and one parallel device (with enhanced data-transmission

capabilities), a mouse or keyboard, and a VGA monitor. On the software side, the system includes a Windows software package that allows background connection with AT&T Mail and BitFax software.

The FingerPoint Mouse

Perhaps the most unusual feature of the NCR 3170 Safari Notebook is its pointing device, the FingerPoint Mouse, which sits in the lower right corner of the keyboard, where the cursor keys are usually located. In fact, the FingerPoint Mouse replaces the cursor keys, with good results.

The FingerPoint Mouse consists of three keys that are aligned horizontally. The center key is round and about the size of a penny, and it can tilt in any direction. Tilting it in any direction moves the mouse in the same direction. The two keys to either side function like the two mouse keys on a Microsoft Mouse.

What about the cursor keys? As it happens, the FingerPoint Mouse can control either the mouse pointer or the cursor. You merely press two keys simultaneously to toggle between the two functions.

How well does the FingerPoint Mouse work? There are two answers to that question. When it is used to control the cursor, the function is fairly straightforward. In fact, in some cases it is better—and definitely more intuitive—than a set of cursor keys. But in mouse mode, the answer involves some personal taste, which is usually the case when mice are involved. Based on an early prototype that I used, I found the FingerPoint Mouse good for small precise movements, such as moving columns of text in a desktop publishing program.

Opinions on the FingerPoint Mouse will vary. However, dedicated mouse users will appreciate the PS/2-style mouse port on the side of the system.

A Portable Docking Station

A docking station—a desktop device that attaches to a notebook and provides additional capabilities—is nothing new. But for its docking station, Safari has provided a novel twist: portability. This docking station is so small that even when it is mated with the notebook, the entire unit can still fit inside some briefcases.

This small size belies the capabilities inside: three bays for peripherals (e.g., a floppy drive) and two expansion-card slots (one full-length AT slot and one half-length XT slot). Depending on how many expansion cards are inserted, there is even space inside for two nickel-cadmium batteries of the same type that is used by the notebook. The total size of the unit, including notebook and docking station, is only 12 by 15 by 3 inches. The weight, loaded with peripherals and two batteries (plus one in the notebook), is 14 pounds.

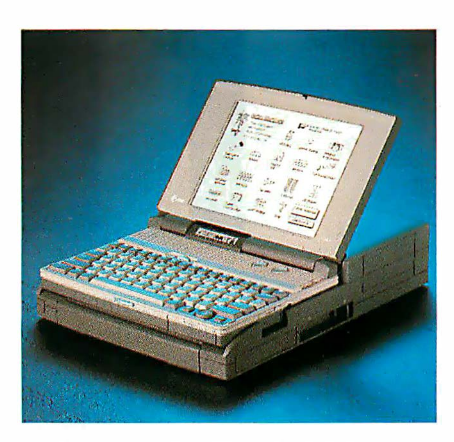


Photo 2: *The docking station is almost as portable as the notebook itself. It weighs only 9 pounds with its batteries.*

Safari envisions the docking station being outfitted with a CD-ROM drive and an RF modem. In fact, an RF modem based on the ARDIS network should be available around the same time the docking station is—near the end of this month.

Multiple Communications Options

Perhaps the most useful feature of the new Safari system is its wide array of communications capabilities and options. Safari designers have obviously not been shy about exploiting the communications expertise of two of its parent companies, AT&T and NCR.

As mentioned above, the NCR 3170 comes standard with a fax/data modem (either 2400 or 9600 bps) and Windows software for accessing fax messages and AT&T Mail. Currently, there is an interesting gateway in AT&T Mail that allows you to send short messages to Telefind alphanumeric pagers. New wireless modems, such as the ones mentioned for the docking station and the PCMCIA slot, should allow two-way wireless communication fairly soon.

Two-way wireless communication is where the NCR connection should come in handy, with its ARDIS cellular network. When these modems become available, Safari owners will be able to purchase modems for either the ARDIS network or the more common voice-based cellular network.

Extras

There is a maximum contrast mode for easier viewing of text. In this mode, all text-mode colors are mapped to either black or white, without any intermediary shades of gray.

There is a CPU speed lock, which lets you bypass the power management facilities and lock in a desired CPU speed for performance-sensitive functions.

Finally, the small LCD window displaying various system-status icons can be seen if the system is open or closed. In addition, a mail icon in this display flashes when the serial port is in use and can be programmed to stay on when a mail message has been received.

Prices for the new notebook were unavailable at press time, but the price of a low-end version with an 80-MB hard drive should be around $4700.

All in all, the NCR 3170 Safari Notebook combines a considerable amount of power, usability, and impressive design in a very small package. Shoehorning Windows into a system that can be easily carried and used in a variety of different locations is no easy task. The BYTE Lab should soon follow up with a review of a shipping version of this system. But until then, this is a system that deserves a good deal of attention. ■

Rich Malloy is an executive editor for BYTE located in New York City. He can be reached on BIX as "rmalloy" and on MCI Mail at #306-6564.

THE FACTS

NCR 3170 Safari Notebook
with 2 MB of RAM, an 80-MB hard drive, and a 2400-bps modem; or with 4 MB of RAM, a 120-MB hard drive, and a V.32 modem with fax capability; prices not available at press time

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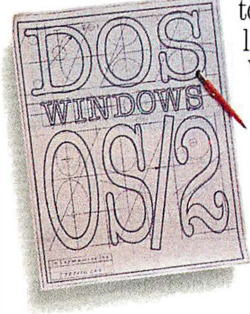
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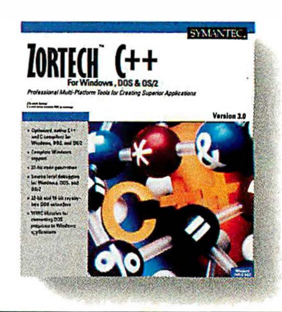
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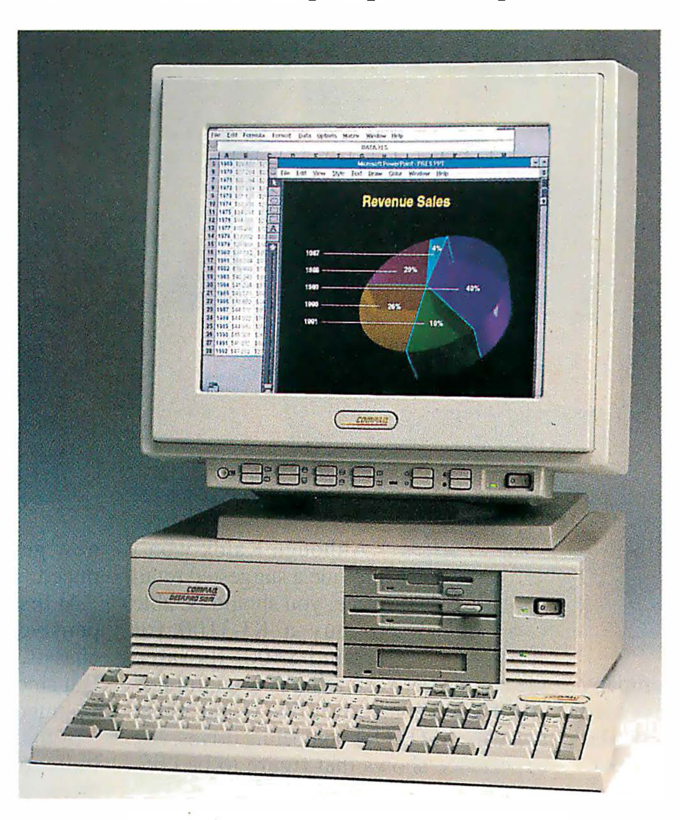




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Circle 129 on Inquiry Card.

New from Compaq: Deskpro 50M



Of the many changes that have occurred at Compaq recently, the most notable are several new products: a 486DX2 processor module, a 1024- by 768-pixel resolution graphics accelerator board, and a 17-inch flat-tension-mask color monitor. Combined, these products form a most impressive graphics workstation, which Compaq calls the **Deskpro 50M**.

The Deskpro 50M has 8 MB of RAM (expandable to 64 MB). You have a choice of a 19-millisecond 120-MB hard drive, a 12-ms 340-MB hard drive, or no hard drive at all. Like the other members of the Deskpro/M family, this machine has a rather standard desktop size (17 by 15 by 6 inches). However, it also features five EISA slots (one used by video), a fairly husky (240-watt) power supply, and a removable I/O board containing ROM chips and the system's CMOS battery.

486DX2 Module

The processor module in the Deskpro 50M is built around the newly announced Intel 486DX2 chip. This chip runs at 50 MHz internally, but it has a special interface that lets it appear to the external world as a 25-MHz chip, which lets designers more easily build systems around it. However, this 25-MHz operation also causes the chip to perform at slightly slower rates than you might expect based on its internal 50-MHz clock. Intel claims that instead of running at twice the speed of a 486DX/25, the DX2 will run merely 50 percent to 70 percent faster, depending on how the memory is organized.

To squeeze as much performance as possible from the new chip, Compaq has augmented the 8-KB internal cache on the 486 with a 256-KB two-way associative write-back cache. Preliminary performance numbers based on BYTE Lab benchmarks and an early prototype of the system suggest this could be one of the fastest DX2 systems on the market.

Compaq has wisely implemented the DX2 on a processor module that can be used as an upgrade processor for owners of other Deskpro/M systems or Systempro/LT file servers. Probably, though, the DX2 processor will be purchased most often as part of the Deskpro 50M.

New Graphics Controller

No matter how fast your processor is, you can get even better graphics performance with a graphics accelerator card. Thus, the Deskpro 50M comes with Compaq's new **QVision 1024/E Graphics Controller**. This EISA card features 1 MB of video RAM, which lets it support 256 colors in 1024- by 768-pixel resolution and 65,000 colors in 640- by 480-pixel resolution, as well as regular VGA.

For enhanced Windows performance, the card features a BitBlt engine and a hardware cursor. For fast AutoCAD performance, the card has a line-draw engine. The net effect of these features is very impressive performance. (An ISA version of the card has slightly slower performance.)

Flat-Screen Monitors

The latest rage in color monitors seems to be flat screens, and Compaq has decided to offer the flattest screens around. The company's new **QVision Color Monitors** are actually large-screen versions of Zenith Electronics' much-admired flat-tension-mask monitors.

Zenith Electronics (not to be confused with the computer manufacturer Zenith Data Systems) has been selling a 13-inch version of the monitor for years, but Compaq is the first company to offer 15- and 17-inch versions. The 17-inch screen that I saw was unique among large monitors, with a screen so flat that it seemed concave.

A New Tradition

At press time, all Compaq would say was that it would watch the market carefully and offer prices competitive with companies such as Dell and ALR, a promise it has made before and followed through on. If this new tradition holds, Compaq will soon be selling one of the most powerful and most cost-effective graphics workstations on the market.

—Rich Malloy

THE FACTS

Deskpro 50M
Model 1: 8 MB of RAM and a 3½-inch floppy drive. Model 120: 19-ms 120-MB hard drive. Model 340: 12-ms 340-MB hard drive.

QVision 1024/E Graphics Controller
1 MB of video RAM, 1024 by 768 pixels with 256 colors, VGA compatible, and an EISA bus interface.

QVision 170 Color Monitor
17-inch diagonal, flat-screen, multiscan color analog monitor, 1024 by 768 pixels.

Prices unavailable at press time.

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FIRST IMPRESSIONS

New Hard Drives Keep Your Data Safe

It's no secret that hard drives are the Achilles' heel of personal computer systems. Unlike the rest of a computer, which moves electrons from place to place, hard drives are electromechanical devices with lots of moving parts that sooner or later wear out—usually at the most inconvenient time.

That hard drives fail is a fact of life. What's an individual user to do? There *are* alternatives, and two new drives are cases in point. The Kalok **KL3100** and the Quantum **Passport XL** take very different approaches to keeping your data safe, but both do the job admirably.





Kalok

Kalok isn't the most familiar name to end users. The company has concentrated on selling its line of hard drives to system makers and dealers. But Kalok is a name you should know about.

Kalok drives are plain-looking (OK, ugly) black boxes that have a disconcerting feature of making a great deal of noise when they access and write data. But don't be fooled.

In one of my prior incarnations as a PC consultant, I computerized a small business with a half-dozen computer systems. In one of them I installed a Kalok drive. I shook my head as I heard it clunk and clank through its paces. Four years later, all the other hard drives I installed have failed. The Kalok, however, just keeps clunking along.

The major reason that Kalok drives are so reliable (and make more noise) is that they use 50 percent fewer components than typical drives from major players. Fewer parts mean fewer pieces to wear out and break down. It works.

The KL3100 is Kalok's latest, a 3½-inch 105-MB IDE drive. It has a 32-KB on-board buffer with a proprietary look-ahead caching algorithm. Couple the cache with a configuration that uses 35 sectors per track, and the result is that the KL3100 delivers more data per rotation than its competitors. I measured its throughput at about 1.8 MBps, the type of speed more commonly seen from synchronous SCSI drives. (The average seek time is 19.5 milliseconds.)

Although Kalok won't provide a suggested retail price, you should be able to buy a KL3100 for around $400. Its rated mean time between failures is an impressive 50,000 hours (over five years), about twice the MTBF for competing drives. My experience shows that figure to be conservative.

Quantum

Last year's acquisition of Plus Development by Quantum was one of those proverbial marriages made in computer heaven. Both companies are known for making high-reliability (albeit expensive) drives. The newest fruit of the merger is a unique system indeed: the Passport XL. This is a series of four removable hard drives (ranging from 50 to 240 MB) that sets new standards for performance and reliability.

Each Passport XL unit is a completely self-contained and sealed SCSI drive in a shockproof container. There are external chassis for PCs and Macs, and an internal chassis fits in a standard half-height 5¼-inch PC drive bay. (You'll also need a SCSI board for your PC.)

The interface to the chassis is a pin connector at the rear of each drive unit. But you don't just push the drive in the chassis. As soon as you start to insert the drive unit, a motor-driven mechanism grabs it and gently pulls it into the chassis. This makes for high reliability. Quantum rates the drives for an incredible 20,000 insertion/removal cycles. That's the equivalent of inserting and removing the drive five times a day for 10 years.

The drives contained in each cartridge are also unique. They have a built-in cache for an effective access time of 9 ms, and they have a sustained data transfer rate of 1.4 MBps. But it's their rated reliability that really raised my eyebrows. Quantum says that the MTBF is 250,000 hours. (That's 28 years!) It's even more impressive when you consider that these drives are designed to be removed, transported, and bounced around. Because of the rated life, Quantum is guaranteeing *forward* compatibility for the Passport XL. The company says you'll be able to use both the drives and the chassis as new generations of products are introduced.

At first blush, the Passport XL seems expensive: A 105-MB drive unit, internal chassis, and SCSI adapter list for $1207. But since it's designed to be a lifetime investment, it's an unbeatable value.

Both the Kalok and Quantum drives are indicative of a refreshing trend toward drives that truly keep your data safe. But a word to the wise: You still need to make backups. Murphy lives.

—Stan Miastkowski

THE FACTS

KL3100
(contact dealer for price)

Kalok Corp.
1289 Anvilwood Ave.
Sunnyvale, CA 94089
(408) 747-1315
fax: (408) 747-1319
Circle 1235 on Inquiry Card.

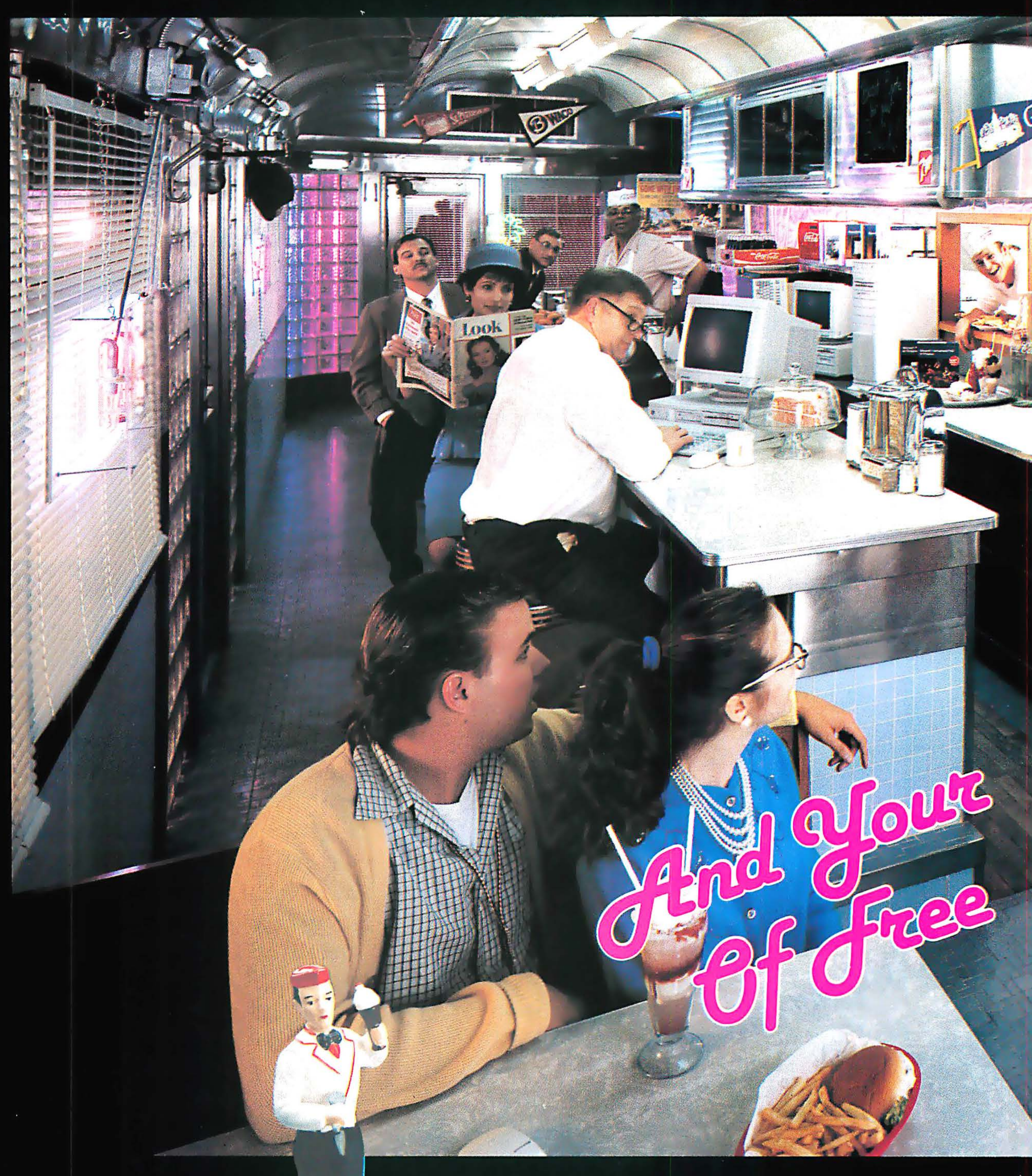
Passport XL
50 MB, $449; 105 MB, $629; 120 MB, $899; 240 MB, $1099
internal chassis, $359
external chassis, $469

Quantum Corp.
500 McCarthy Blvd.
Milpitas, CA 95035
(800) 624-5545
(408) 894-4000
fax: (408) 894-3205
Circle 1236 on Inquiry Card.

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723
SEMPER FIDELIS
COW 1
U.S. MARINE CORPS
GATEWAY 2000

Serving PCs



What comes to mind when you picture the classic 50's diner? Good food and plenty of it. Great service. And the price on the check is remarkably affordable.

When you buy a personal computer from Gateway 2000, the experience has its similarities. You get a solid quality, high-performance computer that comes fully loaded with all the

Gateway Cafe

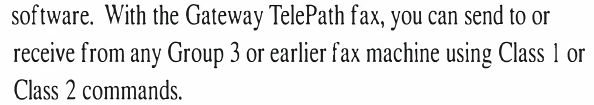
Side Orders

Introducing The Gateway TelePath™

For $195, you get the Gateway TelePath – a new custom-designed V.32bis modem with 9,600 bps fax capability plus WinFax Pro,™ Crosstalk® for Windows™ and a free 30-day subscription to CompuServe® Basic Services. Anywhere else you'd pay more for the software alone!

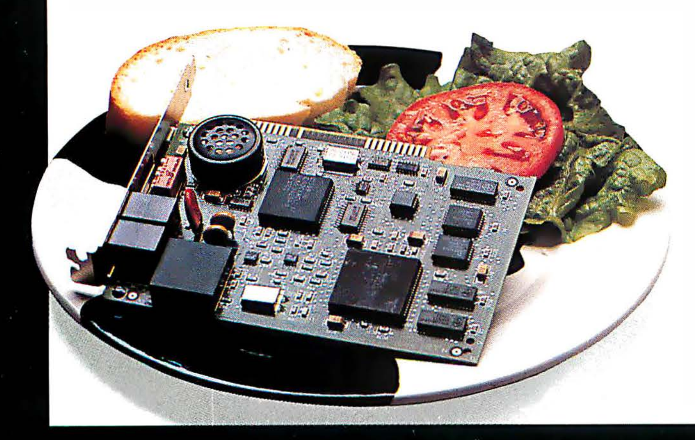
Speed. The Gateway TelePath modem operates up to 14,400 bps. The Gateway TelePath send/receive fax runs at 9,600 bps.

Compatibility. The 14,400 bps modem is compatible with the standard AT command set and can be used with almost any compatible software. With the Gateway TelePath fax, you can send to or receive from any Group 3 or earlier fax machine using Class 1 or Class 2 commands.



- Fax mode: V.17, V.29, and V.27ter
- Data mode: (try to find one we don't support!) V.32bis, V.32, V.22bis, V.22, V.21, Bell 212A and 103, V.42 and MNP 2-4 error correction, V.42bis/MNP 5 data compression

Price. You'll find comparable fax/modem packages can cost in excess of $500 not including the software. At $195, the Gateway TelePath price is very easy to swallow.



Side Orders

New Video Options For Your PC

The 15-Inch Crystal Scan 1572FS

The new 15-inch Crystal Scan 1572FS has a flat, square, non-glare screen to reduce distortion around the corners and provide an edge-to-edge display area. We've also moved the fine tuning controls to the front of the monitor for easy access. The Crystal Scan 1572FS is an option with 386DX and 486 systems for an additional $195. Availability is limited.



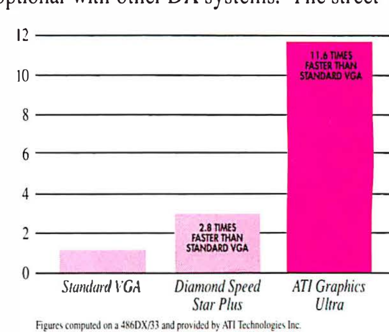


The new 15-inch Crystal Scan is bigger and better than the 1024 series.

The ATI™ Graphics Accelerator

You're really cookin' when you run a Gateway 2000 system with ATI's graphics accelerator, the Graphics Ultra. ATI achieves a quantum leap in performance by using a highly optimized graphics coprocessor on the Graphics Ultra card. The 1024 x 768 mode is fully compatible with IBM® 8514/A, VGA, Super VGA and previous IBM graphics standards, which makes it easy to install applications using the standard video drivers.

The ATI Graphics Ultra video card is standard with the 486DX/33 system, optional with other DX systems. The street price of this card is over $500, but with the purchase of a Gateway 2000 system, you can upgrade to it for $150!



Peripherals are sold only with the purchase of a system. If you already own a Ga



Desserts

Desserts

New On The Menu: Choose One Software Option Free With Your PC!

With the purchase of any Gateway 2000 computer system, you now receive your choice of free application software. Pick one from the seven application options in our software buffet. We'll install one software option on your hard drive, optimally configured for your system and Windows, and provide you with the master diskettes and manuals – absolutely free.



You can also buy additional software at extremely competitive prices, or choose from other popular applications not listed here. Ask your sales person for the details.

Option #1

Microsoft® Excel for Windows™ 3.0

- A powerful graphical spreadsheet program
- Includes online help for Lotus® 1-2-3® users
- *PC Magazine's* Editor's Choice

Retail value: $495. Discount value: $300+. Can be yours free with a Gateway 2000 PC!



Option #2

Microsoft Word for Windows™ 2.0

- Best selling word processor for Windows
- New version 2.0 adds spectacular refinements
- Includes online help for WordPerfect® users

Retail value: $495. Discount value: $300+. Can be yours free with a Gateway 2000 PC!

Option #3

Microsoft PowerPoint for Windows™ 2.0

- Easy-to-use desktop presentations program
- Creates high-quality overheads and 35mm slides

Retail value: $495. Discount value: $300+. Can be yours free with a Gateway 2000 PC!

Option #4

The Paradox® 3.5

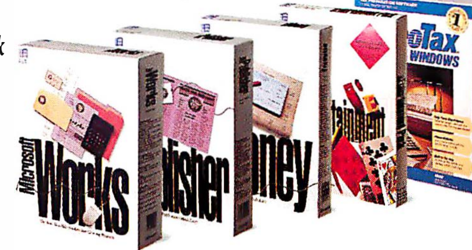


- Award-winning database management program
- From Borland®, the leader in database and programming software

Retail value: $695. Discount value: $500+.
Can be yours free with a Gateway 2000 PC!

Option #5

The Entrepreneur Pack



Includes Microsoft's Works,™ Publisher™ and Money,™ the latest versions, and an Entertainment Pack, all for Windows, plus TurboTax for Windows® from ChipSoft

- Works integrates a word processor, spreadsheet, database and more into one easy-to-use program
- Publisher has page layout tools to create publications
- Money helps you control your finances by writing checks, setting budgets, tracking expenses
- Entertainment Pack, eight games including Tetris®
- TurboTax is an easy-to-use tax preparation program with online help for understanding IRS rules

Retail value: $607. Discount value: $400+. Can be yours free with a Gateway 2000 PC!



eway 2000 computer, you can buy peripherals separately. Availability is limited.

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Desserts

Main Course

Feast Your Eyes On These Entrees – Includin

Option #6

The Windows Programmer Pack

Includes Microsoft's QuickC for Windows,™ Visual Basic for Windows,™ Windows Control Development Kit,™ MS Windows Help Compiler™ and MS Windows Programmer's Online Reference™



- Everything you need to create programs for Windows

You can't buy all of these tools in one package elsewhere, but this option can be yours free with a Gateway 2000 PC!

Option #7

Microsoft Project for Windows™ 3.0

- Flexible and easy project management program
- Includes interactive online tutorial
- *PC Magazine* calls it the best program in its category

Retail value: $695. Discount value: $425+. Can be yours free with a Gateway 2000 PC!

If the free software packages offered here don't suit your needs, we have others that are very competitively priced. For example, if you'd rather get Microsoft Office,™ which includes Word for Windows, Excel and PowerPoint, you can upgrade to it. Office retails for $750, with a discount value of $499. It can be yours for only $175 with a Gateway 2000 PC. Ask your sales representative for details.

This offer includes the identical applications contained in retail packages but will not include the retail box. You get a complete set of diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.



Gateway 2000 computer systems – the meat and potatoes of our menu – come with all the trimmings at no extra charge.

And if you're hungry for an ultra high-performance system at a great price, take a look at our new 50MHz 486DX2 computers. Both ISA and EISA models are based on the Intel486 DX2 dual speed processor. With a system clock frequency of 25MHz, the internal core of this CPU executes at 50MHz for a 35% increase in performance compared to a 33MHz 486DX system.

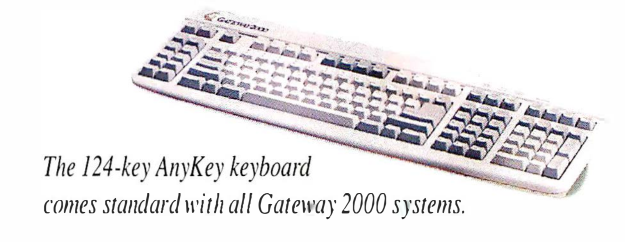
NEW

50MHz 486DX2 $3195
50MHz 486DX2 EISA $4095

386SX Systems

Gateway 2000's 386SX systems come in a compact, mini desktop model. To give you plenty of room for expansion in a small footprint system, we integrated the diskette drive controller, the video chip set and the I/O card on the motherboard, leaving five 16-bit slots open in the standard configuration.

The mini desktop models have a standard mouse port (PS/2[5] compatible), leaving two serial ports open. RAM on these systems is expandable to 16MB on the motherboard. The Western Digital® IDE hard drives feature a 32K read-look-ahead cache buffer. All mini desktop models have Quadtel[3] BIOS and 200 watt power supplies.



The 124-key AnyKey keyboard comes standard with all Gateway 2000 systems.



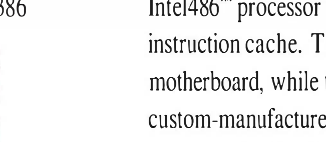
Main Course Main Course

g A New 486DX2 Special!

386DX Systems

The 386DX systems have a true 32-bit memory bus and more expansion capability. We start with a genuine Intel® 80386 microprocessor on a Micronics® motherboard. We add a generous portion of RAM – 4MB expandable to a system total of 64MB. Put in 64K of cache RAM on the 386DX/33 for a nice performance boost. Add IDE hard drives from Western Digital. Then give them Diamond Speedstar Plus™ 16-bit VGA graphics cards with 1MB RAM, non-interlaced 14-inch Crystal Scan 1024 x 768 color monitors, Phoenix™ BIOS, a Weitek socket on the 33 and 200 watt power supplies. That's the basic recipe for these tried-and-true, workhorse computers.





Both systems have a 32-bit slot open in the standard configuration for RAM expansion. The motherboard has a total of one 32-bit and seven 16-bit slots, with one 32-bit and five 16-bit expansion slots available in the advertised configuration. Gateway's 386DX and 486 systems come in a desktop model that is roomy and easily accessible. A floor-standing tower model is an option for an additional $100.

486DX And DX2 Systems

Gateway 2000's 486 systems run on the real McCoy – an Intel486™ processor with built-in math coprocessor and 8K instruction cache. The ISA systems have a Micronics® motherboard, while the motherboard for the EISA systems is custom-manufactured for Gateway 2000. RAM is expandable to a system total of 64MB.

New on the ISA models is the ATI® Graphics Ultra, which is the fastest video card by far in its class. The EISA models include a Diamond Speedstar Plus, which is also a high-performance video card. Both systems come with 1MB video RAM.

The ISA systems have eight 16-bit slots on the motherboard, six available in the standard configuration. The EISA machines have eight 32-bit EISA slots on the system board. You have five 32-bit EISA slots open in our standard configuration.

The ISA systems have Phoenix BIOS, while the EISA computers use Award® BIOS. All systems come with Weitek sockets and 200 watt power supplies.

INCLUDED WITH EVERY SYSTEM:

• One-year limited warranty • 30-day money-back guarantee • Lifetime toll-free technical support • Free on-site service to most locations • Free bulletin board technical support • C.O.D. terms and major credit cards honored • Net 30-day credit terms and leasing options available to qualified commercial customers



Gateway Cafe

16MHz 386SX

- Intel® 80386SX Processor
- 2MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 40MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey™ Keyboard
- Microsoft® Mouse
- MS® DOS® 5.0
- MS Windows™ 3.0
- Choice of Application Software

$1445

20MHz 386SX

- Intel 80386SX Processor
- 32K Cache RAM
- 4MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 80MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$1745

25MHz 386DX

- Intel 80386 Processor
- 4MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 80MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$1895

33MHz 386DX

- Intel 80386 Processor
- 64K Cache RAM
- 4MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$2395

33MHz 486DX

- Intel 80486 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE Drive with 64K Multi-Segmented Cache
- ATI™ Ultra 8514/A Video with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$2945

50MHz 486DX2

- Intel 80486DX2 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE* Drive with 64K Multi-Segmented Cache
- ATI Ultra 8514/A Video with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$3195

*Enhanced IDE with RIDE (Rapid Integrated Drive Electronics) technology.

33MHz 486DX EISA

- Intel 80486 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 340MB 15ms SCSI Drive with 128K Multi-Segmented Cache
- 32-Bit EISA SCSI Controller
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$3895

50MHz 486DX2 EISA

- Intel 80486DX2 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 340MB 15ms SCSI Drive with 128K Multi-Segmented Cache
- 32-Bit EISA SCSI Controller
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$4095

BEST BUYS

- Get our 33MHz 386DX system, same configuration as listed, with a 120MB IDE hard drive instead of the 200MB drive.

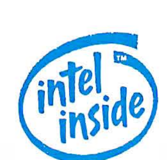
$2145

- Same features as our 33MHz 486DX system except this machine has 4MB RAM instead of 8, and a 120MB IDE hard drive instead of the 200MB drive in our standard configuration.

$2495

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CST)
Service Hours: 6am-Midnight Weekdays, 9am-2pm Saturdays (CST)

All prices are subject to change. Prices do not include shipping.





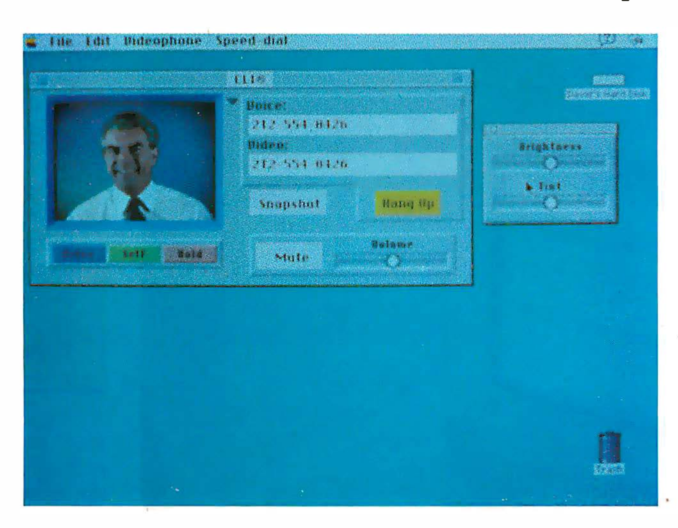
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The VideoPhone Goes Home Computer



The company that provided the compression algorithm and the hardware for the AT&T VideoPhone 2500—Compression Labs—has announced a computer-based version of the same system. The **Cameo Personal Video System, Model 2001** consists of a small video camera that sits atop your Mac. The camera is connected to a *video processor module* that sits beside the system, sidecar-style. The camera passes the image to the video processor and then to an ISDN card in the computer, which transmits it over ISDN lines to another Cameo unit. When your system receives a video image, the video processor passes it to a digitizing video card, which displays it on the monitor.

Unfortunately, those images still suffer from the need to cram lots of video information through a narrow communications bandwidth. At 15 frames per second—about half of what's needed for smooth motion—and a resolution about that of a VHS movie, this is a far cry from the viewscreens on the starship *Enterprise*. (If you don't want a caller to see you, you can close the shutter over the camera.)

The software that comes with the Cameo system is easy to use, mimicking a full-featured telephone. With a click of a mouse button, you can dial, activate the video image, see your own image, mute the audio, hang up, put your party on hold, or take a snapshot of a party's image. A graphical phone directory lets you store those snapshots, so you can later call someone just by clicking on his or her image. Slider bars let you adjust the image brightness and tint, as well as the audio volume (which comes through your regular telephone).

While it's less expensive than previous commercial videophones, the Cameo system isn't cheap. You'll need a Mac IIci, IIfx, or Quadra with System 7.0, QuickTime, a RasterOps digitizing display card, an Apple ISDN card, and access to ISDN lines. If you already have the Mac and the ISDN lines, the extra pieces will cost you about $2000, not including the Cameo system itself, which costs $2095. (The Cameo cost is $1595 if you use your own video camera, which you can plug into the standard NTSC interface on the video processor.)

Given those constraints, Compression Labs is wisely aiming the Cameo system at businesses that are looking for a lower-cost alternative to the expensive teleconferencing systems they've been using. Many of those customers already have the ISDN lines installed.

For the rest of us, however, Compression Labs has plans to branch out very soon. The company says it will have an IBM PC-compatible Cameo system later this year (the video processor itself is platform independent), as well as versions that will operate over normal (i.e., analog) telephone lines (which will make them compatible with the AT&T VideoPhone). Other proposed features include a "chalkboard" that will let you transmit freehand drawings as you talk about them. Those kinds of additions could move the videophone from the realm of technological curiosity to standard consumer device.

—*Kenneth M. Sheldon*

THE FACTS

Cameo Personal Video System, Model 2001
including camera, $2095; without camera, $1595

Compression Labs, Inc.
2860 Junction Ave.
San Jose, CA 95134
(800) 225-5254
(408) 435-3000
fax: (408) 922-5429
Circle 1216 on Inquiry Card.

Blue Dolphin Makes a Splash

The PC price/performance race shows no signs of slowing down, and it's certainly one area where end users are benefiting. The latest conspicuous example is the **486DX-50 Cache** from the interestingly named Blue Dolphin Computers. This is one loaded, powerful, and incredibly fast system at a price that will raise some eyebrows. At $3749 complete, it is (as this was written) the most inexpensive 50-MHz system on the market.

As its name implies, the 486DX-50 Cache is built around Intel's 50-MHz 486 chip, which is finally becoming available in quantity. Besides the 486's internal 8-KB cache, the system includes a 64-KB external static RAM cache. As you'd expect, this is a screamer of a system. My preliminary BYTE Lab benchmark results showed this to be one of the fastest systems we've ever tested.

Running processor- and graphics-intensive applications at this speed is a revelation. It's especially noticeable with a GUI like Windows. There's virtually no delay in applications. One of my personal favorites for subjective performance measurement is AutoDesk's Chaos, which makes heavy use of the 486's built-in math coprocessor. Drawing a standard Mandelbrot set on the 486DX-50 Cache takes just a few seconds. (It can take minutes on slow 386 systems.)

It takes more than a fast processor to make a fast computer, and the 486DX-50 Cache is a well-integrated system. It comes standard with a Diamond Stealth video RAM graphics card with 1 MB of memory. One of the fastest VGA cards



THE FACTS

486DX-50 Cache
$3749

Blue Dolphin Computers, Inc.
890F Cowan Rd.
Burlingame, CA 94010
(800) 345-0633
(415) 259-9890
fax: (415) 259-9898
Circle 1217 on Inquiry Card.

available, the Diamond Stealth includes a number of software drivers, including Windows at up to 1024- by 768-pixel resolution.

The 486DX-50 Cache comes with an Optiquest-2000, a 15-inch flat-screen monitor that handles high-resolution noninterlaced Windows at a display size that makes it eminently usable. The Optiquest-2000 is a high-quality monitor at a fair price, making it a perfect match for the 486DX-50 Cache.

Other standard features include a 212-MB hard drive (either Seagate or Maxtor), a 5¼-inch 1.2-MB floppy drive, and a 3½-inch 2.88-MB floppy drive (soon to be a standard for small floppy drives). There's also 8 MB of RAM (expandable to 64 MB on the motherboard) and the usual complement of ports. Rounding things out are a Key Tronic keyboard and a Logitech mouse. DOS 5.0 and Windows 3.0 are preloaded on the system.

At BYTE, we see many "me-too" clone systems. Too many are hastily put together from substandard parts and pieces, and the companies often go out of business within months. Blue Dolphin is a refreshing exception to this trend. It's been in business for over six years.

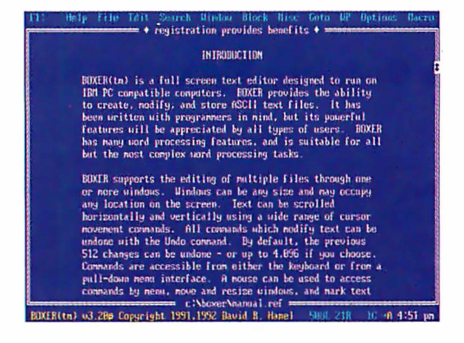
Obviously, the Blue Dolphin 486DX-50 Cache system is also put together from standard parts and pieces. However, the company has done an enviable job of integrating high-performance and mid-priced components into an impressive system. No, it's not a big-name system from a big-name company. Some corners did have to be cut. But Blue Dolphin backs up its products with a 45-day money-back guarantee, a 45-day system replacement policy, a one-year warranty, and lifetime toll-free technical support. If you need (or want) cutting-edge PC performance at an affordable price, the 486DX-50 Cache is the system for you.

—Stan Miastkowski

Boxer: A Text Editor with Punch

One of the easiest ways to launch an argument among programmers is to emphatically state that one text editor is better than another. The **Boxer Text Editing System 3.20** from Boxer Software is a quick, powerful shareware product that deserves to receive some strong support of its own. The text editor's smoothly integrated mouse support is pleasingly comfortable and intuitive.

If you edit text files for a living, you won't find much lacking in Boxer. Although it is restricted to in-memory editing, this should be no problem for many of the programmers for whom Boxer is designed. I was able to load a 163-KB file in a 549-KB DOS session. The memory limitation



appears serious only when you attempt to edit multiple files simultaneously.

This editor has more features than I have space to describe, yet I did not experience feature overload. Each function is but a single menu or keystroke away.

Some of my favorite functions include 26 single-key macros, the ability to write all files with a single command, removing extra blanks from the end of lines, and the addition of configurable headers and footers on printouts. The ability to search and replace text across all open files is a real time-saver. You can perform searches using text only or full regular expression matching, including checks for end of line, start of line, and match only complete tokens.

Boxer provides support for special VGA video modes. In addition to the common 43- and 50-line modes, Boxer provides a

28-line mode, which is useful because the edit area is a standard 24-line screen size.

In addition to standard editor features, Boxer provides a programmer's calculator (hexadecimal, octal, binary, and decimal); the ability to add columns of numbers; an ASCII chart; a movable ruler that measures in inches, millimeters, and picas; a calendar; and a function to remove tabs from text. Because this is a programmer's editor, Boxer provides the ability to compile files and then track through any generated errors.

Both keyboard commands and printer configurations are supported through customizable option files. Command configurations are provided for popular editors (e.g., Brief, Epsilon, WordPerfect, and WordStar). Printer support files include Epson, LaserJet, and Okidata 92. You can easily configure both the keyboard command and the printer configuration files so that you can use them with packages that currently are unsupported.

Boxer does have several interface quirks that I found annoying. The first is the distinction between windows and files. Most multiple-file text editors that I've used open each file in a separate window. Boxer does not do this. Although it supports multiple windows, Boxer also lets you cycle through each file in a single window. Such a separation of files from windows can be quite disconcerting until you become used to working with a text editor that is set up this way.

Another quirk is the implementation of what is called the End-End-End behavior. Brief exhibits this behavior. Pressing the End key once moves to the end of line. Pressing twice moves to the end of screen. Pressing three times moves to the end of document. The Brief keyboard mapping that is provided almost gives this functionality. Boxer, instead of counting End (or Home) presses, checks its position before moving. Thus, pressing End when at the end of a line moves to the end of screen. This subtle difference in behavior is sufficient to cause no end of headaches.

Conclusion? Boxer is well worth a look. The beta version 3.20 I examined was reliable and responsive. Even though I have my own favorite text editor, I'm always looking for a freeware or shareware editor I can carry around with me when consulting on other people's systems. Boxer is a definite addition to my travel kit.

—Raymond GA Côté

THE FACTS

Boxer Text Editing System 3.20
$50 shareware registration fee

Boxer Software
P.O. Box 3230
Peterborough, NH 03458
(603) 924-6602
Circle 1218 on Inquiry Card.

A Touch of CASE from the Gold Coast

PGC CASE Graphics 1.0 from Pacific Gold Coast is an interesting development and design tool that's in need of improvement. This $129 package is not so much a full-fledged CASE tool as it is a diagram-drawing tool. PGC promises additional functionality (e.g., a data dictionary and diagram checking) in six planned modules. However, even a diagram-drawing tool can give the uninitiated a taste of the technology.

PGC CASE Graphics supports several standard diagraming methods: Yourdon data flow, Gane and Sarson data flow, Chen entity-relationship diagram, structure diagram, and structure chart. A special General Graph is provided, which seems to be a catchall for a collection of miscellaneous icons. The documentation claims that you can produce object-oriented programming software designs, but this appears to be limited to the ability to place circles and lines on a drawing.

The working diagram area is limited to the approximate size of a standard VGA screen and cannot be expanded. Because scrolling is not supported in the chart area, your final diagram is also limited to this size.

Diagram icons are presented in an easy-to-use tool bar. However, the tool-bar icons themselves (e.g., an *X* for delete and a camera for copy) are nonintuitive. The complete lack of on-line help definitely hinders the learning process.

One of the package's most useful features is the ability to link multiple diagrams into a hierarchical network. Instead of linking actual icons to the next diagraming level, PGC CASE Graphics links labels. Although this is a little strange in concept, it works quite well because all icons typically have labels with which they are associated.

PGC CASE Graphics does an excellent job of moving icons and connected lines about the diagram quickly and cleanly, providing real-time rubber-banding (i.e., the ability to update and reposition the connecting lines to an icon as the icon is moved). Unfortunately, the text associated with the moved lines does not change position. Thus, after moving a portion of a rather complex diagram, I was forced to move all the labels individually—a task prone to errors.

In spite of the inadequacies I found in PGC CASE Graphics, I was able to create some decent-looking data-flow diagrams and structure charts, an exercise that brought to light some features I want to see in the next release. The ability to resize icons is important, as is the ability to associate labels with lines. The additional capability to group and ungroup icons for copying and moving would also speed diagram development.

For the most part, PGC is on the right track with PGC CASE Graphics. However, I'd wait out the shakedown cruise and look for version 2.0. ■

—Raymond GA Côté

THE FACTS

PGC CASE Graphics 1.0
$129

System requirements:
A 286 or higher with 2 MB of RAM, a VGA or EGA monitor, Windows 3.0, and a Windows-compatible mouse.

Pacific Gold Coast Corp.
15 Glen St., Suite 201
Glen Cove, NY 11542
(800) 732-3002
(516) 759-3011
fax: (516) 759-3014
Circle 1219 on Inquiry Card.

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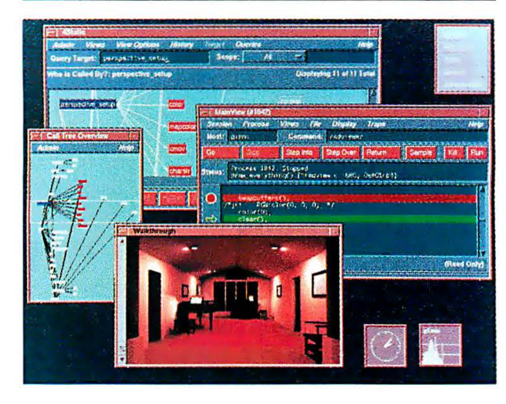







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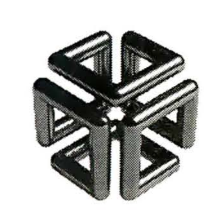
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Portable Presentations in Color

A portable desktop computer with its own color overhead projection LCD panel, the Mpression Notebook Presentation System uses standard overhead projectors to display computer text or graphics. The system consists of a 33-MHz 486 Mport 433 computer with a 120-MB IDE hard drive, plus the LCD panel.

The Mpression displays 256 colors from a palette of 187,000, automatically mapping the CRT colors. The system also automatically expands or compresses VGA modes of different resolutions to fit the 640- by 480-pixel LCD.

To install the system, you plug the cable from the LCD panel into the LCD VGA port of the Mport 433 (which has up to 32 MB of RAM), put the LCD panel on your overhead projector, and turn on the computer for simultaneous overhead and computer displays. The Mpression's 6-foot cable provides video signals and power from the Mport 433. Compatible with DOS, Unix, OS/2, PICK, and DR DOS, the system supports 410-W projectors with the light source below the LCD panel.

Price: $11,995.

Contact: Micronics Computers, Inc., 232 East Warren Ave., Fremont, CA 94539, (510) 651-2300; fax (510) 651-5612.

Circle 1271 on Inquiry Card.



An overhead presentation system, the Mpression Notebook Presentation System combines an LCD panel with its Mport notebook computer.

CPU in a Cartridge

Replaceable CPU cartridges form the basis of the PC Positive 1000 and 2000 upgradable systems. Four cartridges, ranging from a 20-MHz 386SX through a 33-MHz 486, fit either system; an internal CD-ROM is available as an option for either system.

With 4 MB of RAM (expandable to 32 MB), the PC Positive 1000 base system has a 105-MB hard drive, 5¼- and 3½-inch floppy drives, a Super VGA color monitor with a video controller, a 2400-bps modem, a Logitech mouse, and six expansion slots. DOS 5.0, Windows 3.0, Microsoft Works for Windows, and Microsoft Productivity Pack are preloaded on the hard disk. WinFax is packaged with the system.

The basic PC Positive 2000 features 8 MB of RAM (expandable to 32 MB), a 200-MB hard drive, and a 9600-/2400-bps send/receive fax/modem. Prodigy is included, in addition to the software and accessories that come with the 1000 system.

Price: Basic PC Positive 1000, $1400; basic PC Positive 2000, $1900.

Contact: Positive Corp., 9174 Deering Ave., Chatsworth, CA 91311, (818) 341-5400; fax (818) 718-2938.

Circle 1272 on Inquiry Card.



To upgrade the PC Positive 1000 and 2000 models, just change the CPU cartridge.

Desktop System Packages Power

Packaged as a complete system, the ME 486-SX/25 desktop computer includes 4 MB of RAM (expandable to 32 MB via 70-ns SIMMs), 128 KB of 25-ns write-back cache RAM (expandable to 256 KB), an 80-MB hard drive, and dual floppy drives. The system's extended VGA card displays up to 256 colors at a resolution of up to 1024 by 768 pixels on a 14-inch nonglare screen.

The ME 486-SX/25's AMI BIOS offers selectable shadowing. The system has eight 16-bit expansion slots, five drive bays, and an upgradable motherboard.

Price: $1999.

Contact: Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705, (800) 989-9900 or (714) 852-1400.

Circle 1273 on Inquiry Card.

Fast Transfer on the Local Bus

Built on the Opti Local/CPU Bus chip set, Bell's 40-MHz 386 system transfers data at the 40-MHz speed of the CPU rather than at the 8-MHz speed of the AT bus. Since the CPU has its own card, you can upgrade the system.

The system features 4 MB of RAM, 64 KB of cache memory, a 250-MB hard drive, a 1-MB local/CPU bus VGA card, and a 14-inch Super VGA monitor. Also included are one parallel and two serial ports, a mouse, DOS 5.0, Windows 3.0a, and dual floppy drives.

Price: $3495.

Contact: Bell Computer Systems, 6615 Valjean Ave., Van Nuys, CA 91406, (800) 922-1126 or (818) 909-3501.

Circle 1274 on Inquiry Card.

Prolific Possibilities from a Printer

The 6-ppm PostScript Level II Silentwriter Model 95 laser printer has automatic emulation switching that detects PostScript and Printer Control Language files and automatically configures the printer for the proper language. The printer also has automatic interface monitoring that switches between active ports for simultaneous connection of multiple PCs and Macs.

The Silentwriter Model 95 has 2 MB of RAM (expandable to 5 MB). Its 16.7-MHz 68000 microprocessor includes a built-in PostScript Level II interpreter that provides 35 resident scalable typefaces. Built-in trays include a 15-envelope feeder, a 250-sheet cassette that accommodates 24-pound paper and transparencies, and a multipurpose tray that handles 41-pound paper.

An optional PostScript fax/modem lets you send and receive Group 3 faxes as well as PostScript faxes from the printer.

Price: $1749; fax/modem, $599.

Contact: NEC Technologies, Inc., 1414 Massachusetts Ave., Boxborough, MA 01719, (800) 632-4636 or (508) 264-8000; fax (508) 264-8673.

Circle 1275 on Inquiry Card.



Mac and DOS compatible, the Silentwriter Model 95 presents a plethora of printing possibilities.

Draw Multiple Uses from This Graphics Tablet

DrawingPad combines the capabilities of a digitizer, a graphics tablet, and a mouse. Available for the Mac and the PC, DrawingPad lets you create original graphics on your computer as well as convert any paper-based graphical image into a digital form recognized by the computer. After the image is in your machine, you can edit it as you please.

The 2-pound DrawingPad has a resolution of up to 1270 lines per inch with accuracy at ±0.025 inch. It includes 18 user-recordable macros, tablet-to-screen and proportional mapping capabilities, the capability to map the active tablet area to an active window on the screen, and a feature that lets you switch between the mouse and other modes without losing your place on the tablet. You can choose your input device from a number of cordless pen and cursor options.

Price: $395.

Contact: CalComp, Inc., Digitizer Products Group, 14555 North 82nd St., Scottsdale, AZ 85260, (800) 458-5888 or (602) 948-6540; fax (602) 948-5508.

Circle 1276 on Inquiry Card.

Spill-Proof Keyboard

The Membrane Keyboard 101's washable membrane replaces the full-travel keys on a conventional keyboard, but in other respects it matches an Enhanced AT keyboard. Seven ounces of pressure is all that's needed to activate a key, which responds with a light click to let you know your touch was recognized. Interfaces include a keyboard port for an AT or PS/2 computer, an RS-232 serial port, a parallel port, and a universal terminal interface. The scan code serial and parallel versions are fully programmable.

Price: Basic keyboard, $300; universal terminal version, $350.

Contact: Genovation, Inc., 17741 Mitchell N, Irvine, CA 92714, (714) 833-3355; fax (714) 833-0322.

Circle 1277 on Inquiry Card.

Video Editor for Windows

The Editizer video editor from Technical Aesthetics Operations features true A/B roll and SMPTE time-code editing in Windows, as well as integrated tape logging and edit-decision list management support. The combination hardware/software editor encompasses an interface box and software that uses more than 10 independent pop-up windows, including three VCR windows, the Controller window, a Tape Logger window, and an Edit Decision window.

The object-oriented design of the Editizer gives you powerful and sensible access to your data. To change any time code, you click on the time-code number on the screen for a dialog box that lets you set a new number.

You can use the Editizer with your PC to log videotapes and edit, rearrange, and record productions using existing decks. You can connect multiple video decks to any PC that supports Windows and export the Editizer edit-decision list into an industry-standard CMX file to be used by a commercial postproduction firm. Interfaces include RS-232, RS-422, Panasonic AG-1960, and Sony Control-L.

Price: $1995.

Contact: Technical Aesthetics Operations, Inc., 501 West Fifth St., Rolla, MO 65401, (800) 264-1121 or (314) 364-4925; fax (314) 364-5631.

Circle 1278 on Inquiry Card.



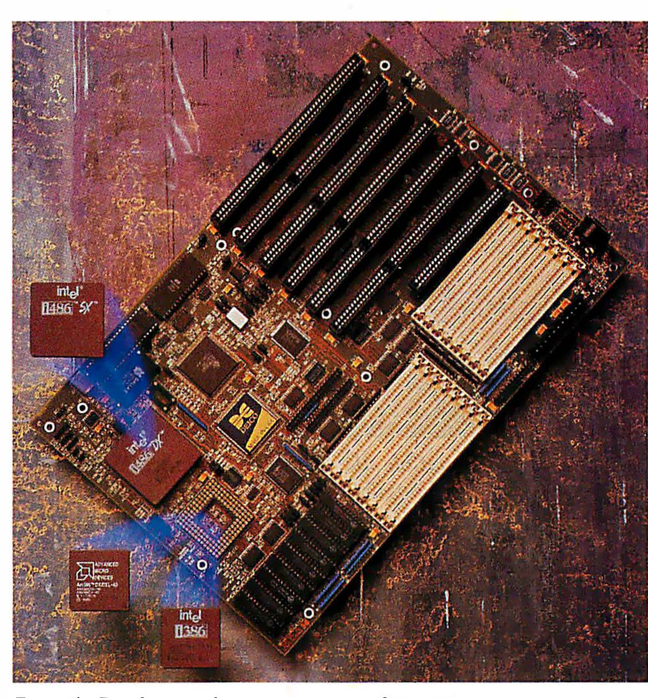
The Editizer, a Windows-based video editor, supports the full life cycle of a video production.

Upgradable Power from Predator

The Predator motherboard is 10 products in one. With a change of the CPU and setup jumpers, the board can be a 25-, 33-, or 40-MHz 386; a 20- or 25-MHz 486SX; a 20- or 25-MHz 487SX; or a 25-, 33-, or 50-MHz 486.

The 8½- by 13-inch Predator features selectable bus speeds and cache memory that is field upgradable from 64 KB to 128 and 256 KB. Able to support multiple operating systems running concurrently, the board is compatible with DOS, OS/2, Unix, and NetWare. Standard interfaces include two serial ports, a mouse port, a bidirectional parallel port, a dual-floppy controller, and an AT interface for IDE hard drives.

Predator's flash memory BIOS is upgradable via a floppy disk. The board, which ships with no system memory, supports up to 16 SIMMs, allowing system memory of up to 64 MB.
Price: With 64 KB of cache memory, $450.
Contact: Deico Electronics, Inc., 2800 Bayview Dr., Fremont, CA 94538, (510) 651-7800; fax (510) 651-6109.
Circle 1279 on Inquiry Card.



Deico's Predator takes on many configurations.

Cross-Platform Media Compatibility

Based on Intel's Digital Video Interactive technology and 750B video processor, the EyeQ Delivery board compresses and decompresses 30-frame-per-second full-screen video to the hard disk on your desktop computer in real time. With 2 MB of video RAM (expandable to 4 MB) and four application-specific ICs, the NuBus board supports 12- and 13-inch Mac displays and multisync displays up to 16 inches (800 by 600 pixels). The board lets you play MacDVI media files on any DVI system.

The EyeQ Delivery board has a data transfer rate of 150 KBps and includes support for NTSC and PAL video standards. Other features include QuickTime compatibility, QuickDraw graphics acceleration, high-fidelity audio, video overlay, and support for multiple compression algorithms.
Price: $2495.
Contact: New Video Corp., 220 Main St., Suite C, Venice, CA 90291, (213) 396-4000; fax (213) 396-0282.
Circle 1280 on Inquiry Card.

Six-in-One I/O Board

Integrating the functions of six boards on a single board, the Sigma Six is designed for the AT bus. The board includes 10-Mbps Ethernet connectivity, a 9600-/2400-bps send/receive fax/modem, Super VGA with 1024- by 768-pixel noninterlaced resolution and a 70-Hz refresh rate, Windows 3.0 compatibility, DOS 5.0 software in flash EPROM, IDE and floppy drive controllers, and parallel and serial ports.
Price: $695.
Contact: Advanced Micro Technology Computers, Inc., 123 University Pkwy., Pomona, CA 91768, (800) 487-4539 or (714) 598-6120.
Circle 1281 on Inquiry Card.

Micro Channel Memory Enhanced

The BocaRAM.MCA32 memory enhancement board supplies up to 32 MB of SIMM memory to IBM 32-bit Micro Channel computers, letting them run operating systems such as DOS, OS/2, Unix, Xenix, and NetWare. The memory on the board can be extended, expanded, or a combination of both. Memory configurations are directed by a menu-driven installation program; the MC32TEST utility verifies that the board is working properly. A driver for EMS 4.0 is included.

Configurations of BocaRAM range from unpopulated to 32 MB. You can upgrade board memory by adding SIMMs.
Price: $295 to $3295.
Contact: Boca Research, Inc., 6413 Congress Ave., Boca Raton, FL 33487, (407) 997-6227.
Circle 1282 on Inquiry Card.

Display Adapter for PowerBooks

The Notebook Display Adaptor 030, an 8-bit display adapter for use with the Macintosh PowerBook 140 and 170, drives 13-inch color displays and projection devices that have up to 256 colors. With a pass-through memory port that accepts an Apple 2- or 4-MB memory upgrade, the adapter is available with or without 2 or 4 MB of RAM on-board.
Price: $795.
Contact: Envisio, Inc., 510 First Ave. N, Suite 303, Minneapolis, MN 55403, (612) 339-1008; fax (612) 339-1369.
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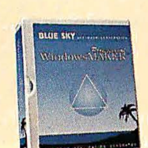
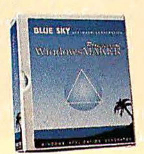
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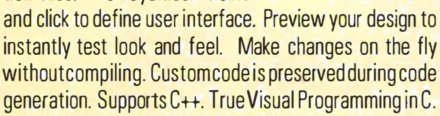
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Greenleaf ViewComm	319

Dan Bricklin's Demo II



Experience for yourself why 30,000 people have made Demo II 3.0 the leading tool for producing program prototypes, demonstrations, and tutorials. Demonstrate commercial software to potential customers without shipping live software. Produce effective tutorials that interactively teach products. Create Computer Based Training for a fraction of the cost of dedicated CBT authoring software.

List: $249 **Ours: $215**

FAX*cetera* # 0233-0003

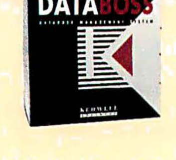
MS C/C++ 7.0 Bundles

w/object-Menu	549
w/Greenleaf Comm++	435
w/CASE:W (C/C++)	1089
w/CodeBase 4.5	549
w/.RTLink/Plus or .RTPatch	CALL
w/MKS RCS	449
w/Zinc Interface Library	609
w/Tools.h++	519
w/C-scape	609

MS C/C++ Competitive Upg.

w/object-Menu	389
w/Greenleaf Comm++	279
w/CASE:W (C/C++)	929
w/CodeBase 4.5	359
w/.RTLink/Plus or .RTPatch	CALL
w/MKS RCS	299
w/Zinc Interface Library	449
w/Tools.h++	359
w/C-scape	449

DataBoss 3.5



Rational DBMS application generator used to develop complete database applications with menus, forms, pick lists, memo windows, reports and more. Includes sophisticated screen painter, field definition template, WYSIWYG report designer, modifiable skeletal files and generator engine which generates structured "C" or Pascal source code. Source code included for all libraries.

List: $695 **Ours: $579**

FAX*cetera* #3758-0001



Product of the Month: WATCOM C9.0/386

NEW RELEASE! NOW SUPPORTS OS/2 2.0

Develop and debug 32-bit applications for extended DOS, Windows, and OS/2 2.0 with the most complete 32-bit C development package available. Includes the royalty-free DOS/4GW DOS extender by Rational Systems, components from MS Windows SDK, compiler, linker, debugger, profiler, plus numerous development tools. Supports other industry standard 32-bit DOS extenders. Create ADS Applications for AutoCAD or embedded systems development.

List: $895 **Ours: $719**

FAX*cetera* #1683-0001

C Screens

C Worthy	399
Greenleaf Data Windows	315
Vermont Views	415
Vitamin C	339

C- Additional Products

C-Doc	169
MKS LEX & YACC	199
PC Lint	105

C++ Libraries/Utilities

BrieforC++	CALL
C++Views	419
Codebase ++	225
Greenleaf Comm++	289
ObjectGraphics	CALL
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Rogue Wave Math.h++	269
Rogue Wave Tools.h++	269
Win++	185

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Programmer's

software source!

atabase Development

larion Professional	525
lipper	521
ataBoss 3.5	579
BASE IV	CALL
BASE IV Devel. Edition	845
oxPro	489
oxPro Distribution Kit	CALL
aradox 3.5	525
+E Database Library	279
&R Code Generator	219
&R Report Writer	219
ay What!	45
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Topaz	89
Turbo Pascal for Windows	175
Turbo Pascal Professional	209
Turbo Professional	99

Prototyping

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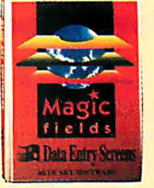
Version Control

MKS RCS	CALL
PVCS Config. Builder	209
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Blue MAX	105
HIJAAK	139
Hold Everything	159
INSTALIT	135
Label Master	399
MKS Toolkit	199
Norton Anti-Virus	99
Norton Commander	99
Norton Utilities 6.0	129
Opt-Tech Sort/Merge	119
PC Tools Deluxe 7.0	129
SpinRite II	69
Stork Installation	CALL
SUNSHOW Image Library	CALL
UpShot	139

Magic Fields™ for Windows

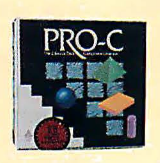


Save time by creating Windows data entry screens the easy way. Magic Fields is a large collection of objects that perform data field validation. Just point & click to define intelligent input fields (numeric, text, date, currency, phone no., etc). Fully customizable including fonts, colors & 3-D NeXT look. Extremely powerful. Use any Windows resource editor. No royalties.

List: $349 **Ours: CALL**

FAX*cetera* #2602-0004

PRO-C



PRO-C is a complete C source code application generator that produces commented, fully documented, error-free C code. PRO-C Workbench (included) allows users to customize their applications. Features include: screen, report, menu and batch update modules; interfaces to many database formats. (PRO-TREE and Btrieve 5.0 file managers are included); segment-ed keys; relational capabilities; mouse support; and password protection.

List: $795

FAX*cetera* #1983-0001 **Ours: ~~$699~~**

SPECIAL OFFER! NOW $99

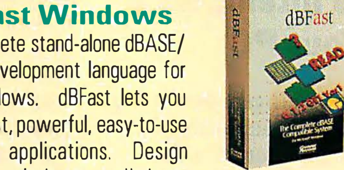
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- Offer does not apply towards obvious errors in competitors' ads.
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dBFast Windows



The complete stand-alone dBASE/xBASE development language for MS Windows. dBFast lets you create fast, powerful, easy-to-use graphical applications. Design multiple windows, pull-down menus, check boxes, list boxes, radio buttons, bit-map pictures and more. Over 200 extensions to the dBASE III Plus language as well as an interactive editor, compiler, and linker.

List: $550 **Ours: $295**

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ick Editor	154
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ORTRAN

ahey F77L	535
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VATCOM FORTRAN 77/8.5	449

raphic Libraries

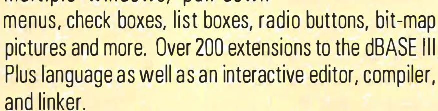
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ssential Graphics Kernal	149
raf/Drive Plus Dev.	269
aphics-MENU	189
X Effects 2.0	179
X Graphics	179
X Text 2.0	125
alo Professional	279
CON-TOOLS	279
enuet	279
UNSHOW Products	CALL
GL 2D, 3D	CALL
ctor Image Library	179

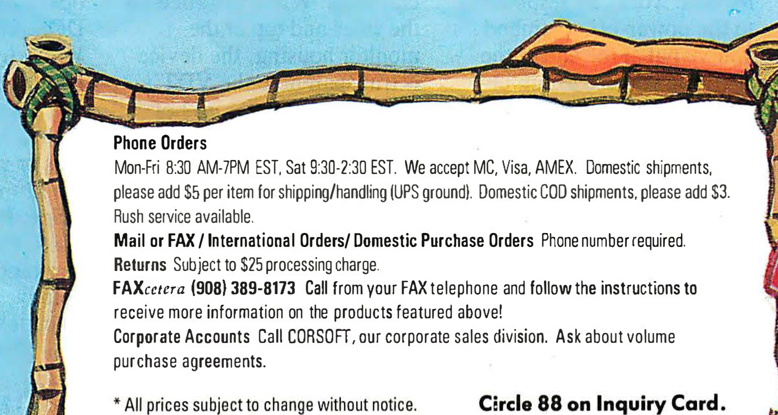
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Mon-Fri 8:30 AM-7PM EST, Sat 9:30-2:30 EST. We accept MC, Visa, AMEX. Domestic shipments, please add $5 per item for shipping/handling (UPS ground). Domestic COD shipments, please add $3. Rush service available.

Mail or FAX / International Orders/ Domestic Purchase Orders Phone number required.

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FAX*cetera* (908) 389-8173 Call from your FAX telephone and follow the instructions to receive more information on the products featured above!

Corporate Accounts Call CORSOFT, our corporate sales division. Ask about volume purchase agreements.

* All prices subject to change without notice. **Circle 88 on Inquiry Card.**

Paradise

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A Case for the Mac PowerBook

Magenta Seven's MagentaCase padded carrying case for the Macintosh PowerBook is made of resilient Du Pont 1000-denier Cordura nylon and closed-cell foam to protect the notebook during travel. Pockets and pouches carry all accessories, such as the power pack and as many as five batteries. The case is designed so that you can use the PowerBook without removing it, easing the problems of computing while on a plane or in a car.

Magenta Seven automatically enters owners into a lost-and-found registry. Each MagentaCase is uniquely coded, so if it is lost or stolen and then recovered, the company can identify the owner. Owners may elect to register their PowerBooks with the company.

Price: $119.95.
Contact: Magenta Seven, Inc., 5109 Holly Ridge Dr., Suite 209, Raleigh, NC 27612, (919) 787-2787; fax (919) 787-1277.
Circle 1284 on Inquiry Card.



The MagentaCase comes in a variety of colors.

FDDI Tester

A hand-held, battery-powered Fiber Distributed Data Interface tester, the Model LCT 100 Link Confidence Tester can test FDDI links and stations to test networks and troubleshoot network problems. The LCT 100 tests protocols and optical performance, and you can use it to verify that your cable's performance is adequate for FDDI. The unit tests connection management and link confidence, as well as link error rate.

Price: $5900.
Contact: Fotec, Inc., 529 Main St., Box 246, Boston, MA 02129, (800) 537-8254 or (617) 241-7810; fax (617) 241-8616.
Circle 1285 on Inquiry Card.

Give Intelligence to Your PC

The Intelligent Power Module automatically powers off your PC when your system finishes its unattended jobs. Activated by receiving on/off signals from your PC via a signal cable connected to the PC's parallel or serial port, the module sits in-line between a wall outlet and a power strip.

The Intelligent Power Module works by responding to the power-off command you've put at the end of the BAT file you use to run unattended operations. When the job is complete, your PC sends the signal to the module to shut down the system. The unit ships with software commands on a floppy disk and a signal cable to attach to your PC.

Price: $59.
Contact: Server Technology, Inc., 2332-B Walsh Ave., Santa Clara, CA 95051, (800) 835-1515 or (408) 988-0142; fax (408) 988-0992.
Circle 1286 on Inquiry Card.

External Blocking of ELF Radiation

ELF ProTech, an externally mounted, extremely low frequency magnetic field suppressor for video display terminals, reduces your VDT's ELF magnetic field to significantly less than the 2.5-milligauss guidelines prescribed by MPR II, according to NoRad. The shielding device is made of a highly specialized alloy, modified by NoRad to attract and absorb magnetic fields radiating from the monitor.

You can use ELF ProTech to retrofit an existing monitor without using special tools. When installed on the sides and top of the monitor housing, the device is transparent to the VDT's performance and does not impair image quality while it reduces ELF magnetic field strength from the front, back, sides, and top of the monitor.

Price: $49 to $99, depending on number of panels required.
Contact: NoRad Corp., 1549 11th St., Santa Monica, CA 90401, (310) 395-0800; fax (310) 458-6397.
Circle 1287 on Inquiry Card.

Standby Computing Power

Available in 250-VA and 450-VA models, the Patriot standby power system is rated UL 1449 for its full-time lightning and surge protection. Patriot protects against high-voltage conditions by switching the load from line to inverter. The system provides full-time EMI/RFI protection via its advanced multistage filter for 33 dB of common-mode and 47 dB of normal-mode noise isolation. Two audible alarms and a triple-mode status indicator light to warn of overloads or a low battery are included.

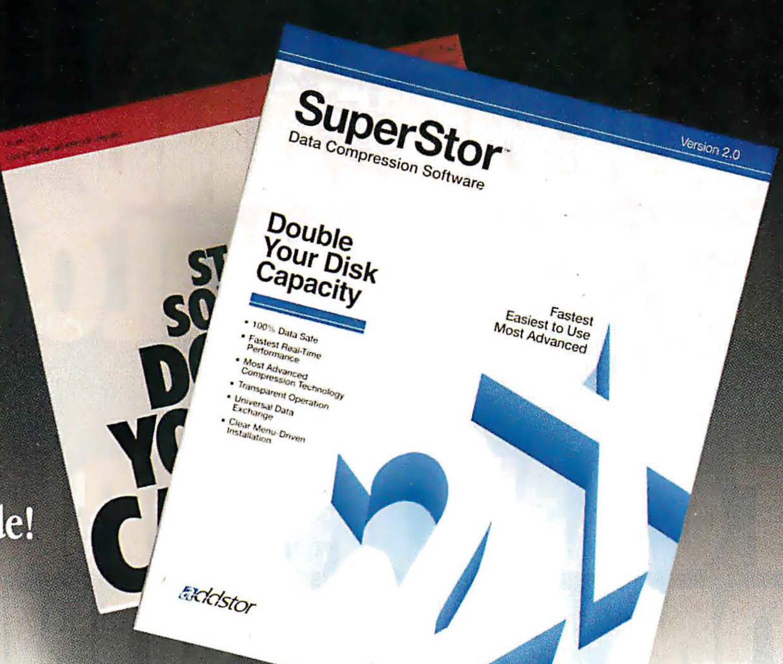
The Patriot 250 VA supports small stand-alone computers, including the Mac SE/30. It can support a PS/2 Model 30 with a VGA monitor for 22 minutes.

The Patriot 450 VA has an interface port that lets it trigger a safe, orderly shutdown and includes Check-UPS software and automatic shutdown kits for operating systems such as DOS, OS/2, AS/400, NetWare, LAN Manager, LANtastic, and Unix/Xenix. The Patriot 450 can support a PS/2 Model 55 for 18 minutes or a Sun-3/60 system for 12 minutes.

Price: Patriot 250 VA, $169; Patriot 450 VA, $279.
Contact: Best Power Technology, Inc., P.O. Box 280, Necedah, WI 54646, (800) 356-5794; fax (608) 565-2929.
Circle 1288 on Inquiry Card.

Data Compression of course, but

Which One?



Why not go with the real-time data compression software being used by more PC users worldwide!

Just install SuperStor 2.0 and you instantly increase your disk capacity by 2-3 times! Then use your computer the way you normally do, no extra commands or keystrokes are required.

SuperStor 2.0 provides up to 25% greater compression than before! It's the fastest, most advanced product of its kind, with many unique features that make it more powerful, easier to use, and far more flexible than the competition. Just look at the chart to review SuperStor's numerous features–many of which are not offered by other compression products.

SuperStor 2.0 is not only the most powerful, it's the most user friendly, too! Clear, colorful graphic displays make installing and using SuperStor simple. And, SuperStor 2.0 runs with all popular operating systems and application programs.

So when choosing data compression, SuperStor is the one!

For more information, please call 1-800-732-3133.



3905 Bohannon Drive
Menlo Park, CA 94025
Tel: 800-732-3133 ▪ Fax: 415-688-0466

Not all data compression products are created equal!	*SuperStor New Version 2.0*	Stacker 2.0
Compresses hard drives, RAM, floppy, and other removable media by an average ratio of 2:1, doubling your disk capacity!	YES	YES
Real-time on the fly data compression doesn't slow down your PC!	YES	YES
Universal Data Exchange allows compressed floppies or removable drives to be read and saved by any PC!	YES	NO
Fully integrated menu-driven software program offers ease of installation and operation!	YES	NO
Advanced Compression Utility Tool Kit scans, checks, and repairs compressed data!	YES	NO
Advanced Disk Optimization Utility defragments or consolidates compressed data for optimal disk performance!	YES	NO
Highest compression ratio of any data compression software (up to 25% greater with version 2.0!).	YES	NO
Automatically updates CONFIG.SYS on physical partition to further enhance transparent operation!	YES	NO
Dynamically adjusts drive capacity to fit more data on compressed disks with less effort!	YES	NO
Performance enhancing Disk Cache results in faster system performance!	YES	YES
Device driver easily loads high, maximizing conventional memory for RAM-intensive applications!	YES	YES

Circle 170 on Inquiry Card.

IF IT HAS ADOBE* SCALABLE FONTS, COLOR, AND QUIET TECHNOLOGY,

IT CAN ONLY BE FROM PANASONIC.



The KX-P2124, a 24-pin with ATM and color option.*



A few dot-matrix printers offer you scalable fonts.

A few, color. But no other printer offers you scalable fonts...color...and Panasonic® Quiet Technology.

Put our KX-P2124 and 2123 to work and you'll get the flexibility of Adobe Type Manager® and scalable fonts...you'll add drama to your documents with our optional color kit...and you'll hear very little, indeed.

Put any of our other Quiet Technology printers to work and you can accomplish whatever your needs.

From our 2123, a budget-minded 24-pin with Adobe Type Manager* and optional color...to our 2624 wide-carriage business printer with ATM*,...to our 9-pin 2180 with 6 near letter quality fonts and optional color.

All with the kind of features that made Panasonic printers the leaders of the industry. Such as multiple paper paths, EZ™ Set control panels, and a two-year limited warranty on parts and labor†.

The Panasonic 2000 Series Quiet Technology Printers.

Call us for more information: 1-800-742-8086. Or visit your Panasonic dealer.

†See your dealer for warranty details.

*ATM and Adobe Type Manager are registered trademarks of Adobe.

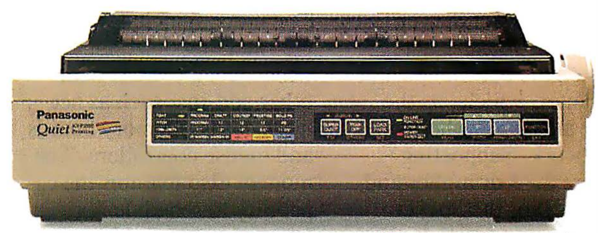
Available on selected printers only.



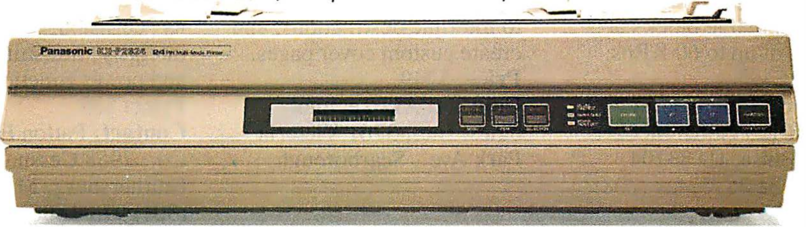
ONCE YOU'VE TRIED OUR QUIET TECHNOLOGY PRINTERS, YOU'LL NEVER SETTLE FOR ANYTHING LESS.



The KX-P2123, a 24-pin with ATM and color option.*



The KX-P2180, a 9-pin with color option. ATM not available.*



The KX-P2624, a 24-pin with ATM. Color option not available.*

PQ9-BY

Circle 99 on Inquiry Card.

Phone and Fax While on the Move

FaxPak, an integrated cellular phone and fax machine, uses a cellular transceiver from Motorola, ensuring reliable performance in remote areas, according to the company. With a five-page document feeder and 98-foot rolls of paper, the FaxPak provides easy faxing while you're traveling.

Compatible with standard office fax machines, the 1-ppm FaxPak FP-100B can be powered three ways: via its internal rechargeable batteries, a cigarette lighter adapter, or an AC 110-V adapter. The sealed lead-acid batteries recharge whenever the unit is connected to an external power source, permitting you to use it while the batteries are charging.

Price: $2295.

Contact: Infinidisc Corp., 7 Littleton Rd., Westford, MA 01886, (508) 692-0898.

Circle 1289 on Inquiry Card.

Pocket a Parallel Port Print Server

You can install the Pocket Print Server ESI-2828A for 10Base-T networks on the parallel port of any printer, which lets the printer attach anywhere on the network. Supporting NetWare 2.15 or higher and NetWare 386, the Pocket Print Server's parallel interface transfers data into the printer in large blocks at speeds of up to 60 KBps.

Price: $495.

Contact: Extended Systems, 6123 North Meeker Ave., Boise, ID 83704, (208) 322-7575; fax (208) 377-1906.

Circle 1290 on Inquiry Card.



The FaxPak integrated solution to the portable office gives you first-rate communications in the field.

Fax from Your Desktop

The 2400 ETC-Fax internal modem supports V.42 error correction and V.42bis and MNP level 5 data compression. Able to send and receive faxes at 9600 bps, the fax modem is compatible with Group 3 and EIA Class 1 fax machines. The modem includes Multiple Interrupt Selection, which lets it coexist with other add-ins, such as network cards, memory boards, and mouse controllers. The modem also features the capability to schedule fax transmissions during off-peak hours, broadcast faxes to multiple destinations, and create custom cover pages.

Price: $249.

Contact: ATI Technologies, Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2, (416) 756-0718; fax (416) 756-0720.

Circle 1291 on Inquiry Card.

Miniature MAU

Patton Electronics' Model 2100 MiniMAU 10Base-T transceiver/multistation access unit lets you use your Ethernet attachment unit interface ports to communicate over twisted-pair cable. The 2- by 1.68- by 0.79-inch unit with CMOS circuitry supports cable runs of up to 300 feet without AC power or batteries. Raised LEDs are readable from most angles for easy monitoring of autopolarity, collision, jabber, link integrity, transmit, receive, and power functions.

Price: $89.

Contact: Patton Electronics Co., 7958 Cessna Ave., Gaithersburg, MD 20879, (301) 975-1000.

Circle 1292 on Inquiry Card.

Qmodem 5 Offers New Features

Version 5 of Qmodem adds a number of enhancements to the communications program. The major addition, the Off Line Mail Reader, lets you download packets of mail from an originating BBS and read them off-line at your leisure. The feature also lets you write your replies off-line and then upload them for sending.

New features in the Dialing Directory let you specify the directory entry setting, such as name of service, phone number, and baud rate, for automatic dialing of subsequent calls. Other additions to the Dialing Directory include the capability to attach notes to any dialing entry, automatically redial an unlimited number of entries, and sort your directory by an entry's name, phone number, or total number of calls.

Terminal emulations added to Qmodem include the IBM 3101, DEC VT52, and Heath Zenith 19. You also can now preconfigure the program for more than 90 commercial modems. The learn mode now lets you create automated scripts to record repetitive tasks. The scripts help you by automating common functions such as log-in sequences, transferring files, downloading messages, and sending replies.

Price: $99.

Contact: Mustang Software, Inc., P.O. Box 2264, Bakersfield, CA 93303, (805) 395-0223; fax (805) 395-0713.

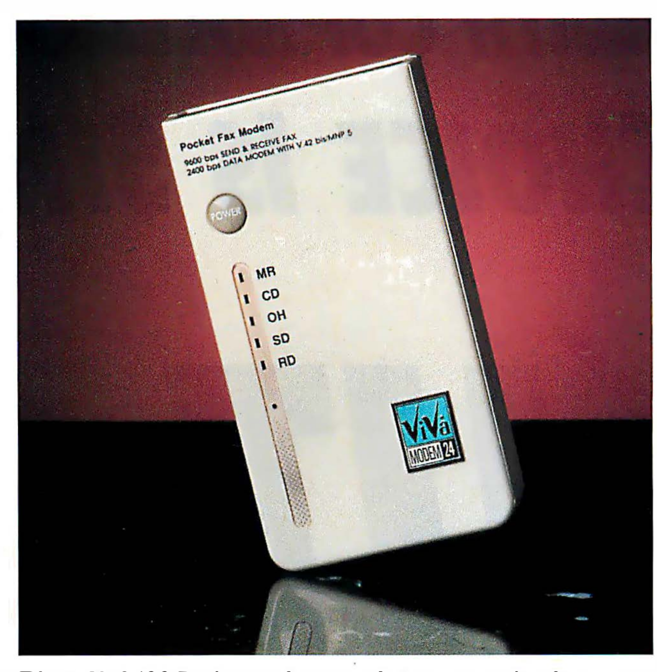
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Mini Modem for Portables

The ViVa 2400 Pocket modem lets you communicate with remote computers or time-sharing systems via your portable computer. The 6½-ounce, 2400-bps unit works in full-duplex mode over a dial-up or two-wire leased telephone line.

Able to automatically dial a call and answer incoming calls over the phone line from a remote system, the ViVa 2400 Pocket can redial a busy number and dial an originate-only modem. The four LEDs include a modem-ready light that indicates when the unit is receiving power, two lights that show when a carrier is detected and when the battery is low, and a light that indicates when the unit is operating at high speed.

The modem comes with communications software, a wall-mount power pack, and a 9-V battery. Software packages supported include Smartcom II 2.1, Symphony, WordStar 2000, PC-Talk, Crosstalk, and Sidekick.
Price: $139.
Contact: Computer Peripherals, Inc., 667 Rancho Conejo Blvd., Newbury Park, CA 91320, (800) 854-7600 or (805) 499-5751; fax (805) 498-8306.
Circle 1294 on Inquiry Card.



The ViVa 2400 Pocket modem travels in your pocket for use anywhere.

Take Automatic Inventory of Your LAN

The LAN Directory hardware and software inventory program gathers and reports information in hundreds of categories for each workstation on your LAN. The utility automatically audits workstations and file servers for information and can inventory standalone personal computers by running the software at each machine. You can audit external devices manually and then enter the information into the software.

The custom reporting feature in LAN Directory lets you create your own reports or build on and modify the reports that are included in the utility. You can create multiple headers and footers and move text around the screen, placing the title and data areas wherever you wish. You can gather LAN workstation data automatically by adding a command to the log-in script.
Price: $495.
Contact: Frye Computer Systems, Inc., 19 Temple Place, Boston, MA 02111, (617) 451-6364; fax (617) 451-6711.
Circle 1295 on Inquiry Card.

A Modem for Secure Communications

The SecureModem 2032e has the double security feature of callback access control and DES data encryption. The dual feature protects dial-in networks from unauthorized access and secures sensitive data transmission against illegal tampering and monitoring.

The SecureModem 2032e has V.42 error control and MNP level 5 data compression, a combination that enables error-free encryption throughput of 19,200 bps. The desktop unit's full-screen menus are easily configured to automatically authenticate an incoming call, perform call-back or pass-through, and secure communications by scrambling data.
Price: $895.
Contact: Cettlan Corp., P.O. Box 397, Irvine, CA 92650, (714) 559-4016; fax (714) 262-0708.
Circle 1296 on Inquiry Card.

Create a Skyline View of Network Traffic

Skyline/E, a Macintosh-based network-analysis tool, provides managers of mixed-vendor, multiple-protocol networks with a history of Ethernet network traffic. Designed to provide a visual overview of network traffic, Skyline/E captures and stores data over extended periods.

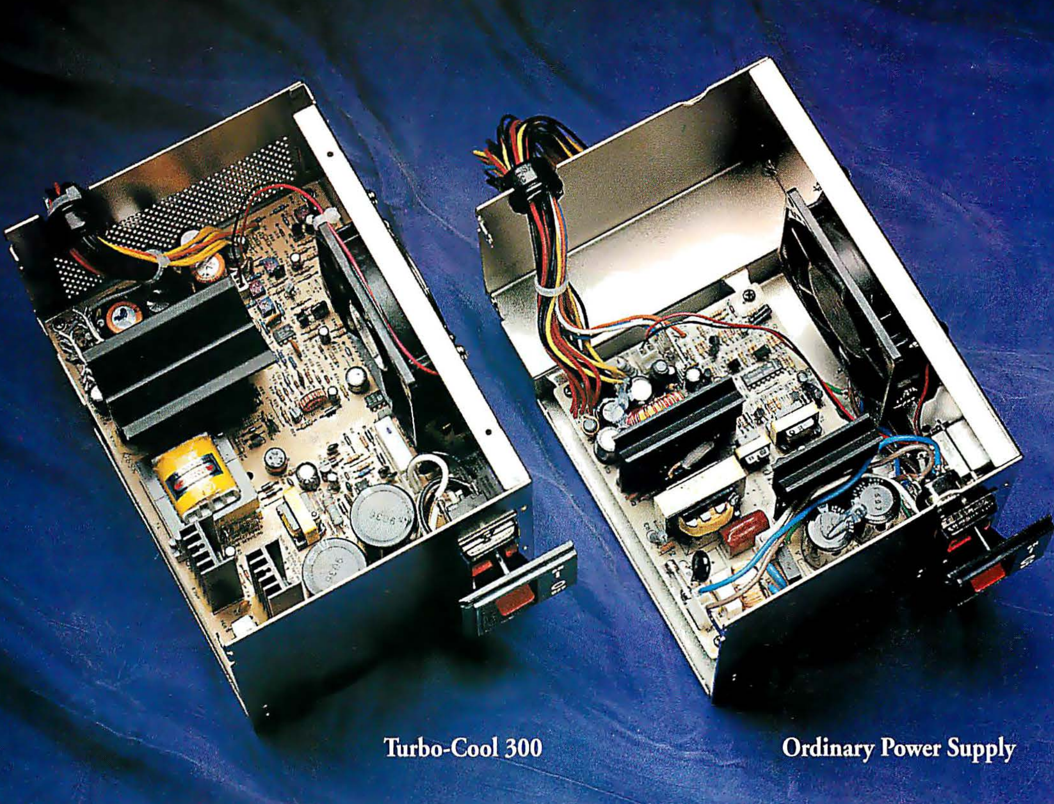
The main window shows a histogram-type chart with bars that represent network use over a length of time of from 1 second to hours or days. You can assign colors and levels of use to the bars for an instant picture of traffic over a designated period.
Price: $695.
Contact: The AG Group, Inc., 2540 Camino Diablo, Suite 202, Walnut Creek, CA 94596, (510) 937-7900; fax (510) 937-2479.
Circle 1297 on Inquiry Card.

Eight-Port Hub for 10Base-T

An eight-port 10Base-T Ethernet concentrator, the 10T Hub/8 includes a BNC port for connecting to thin coaxial cable. The hub features auto-partitioning, which automatically shuts down a bad port when the hub detects jamming signals, and it has the ability to shut off Link Integrity port by port. It includes an in/out-selectable unshielded twisted-pair port that lets you connect to other hubs with UTP cabling.
Price: $399.
Contact: Asanté Technologies, Inc., 404 Tasman Dr., Sunnyvale, CA 94089, (408) 752-8388; fax (408) 734-4864.
Circle 1298 on Inquiry Card.

LOOK AT THE INSIDE STORY ON POWER SUPPLIES.

What power supply is inside your computer? If you are like most people, you don't know, and frankly, don't care. But, because your computer's power supply is a critical system component, what you don't know, may hurt you. An inferior power supply can cause interference, rebooting, hard drive errors, and other nasty hard-to-track problems. So why take chances? Call the power supply specialists at PC Power and Cooling today.



Turbo-Cool 300 | Ordinary Power Supply

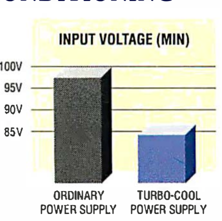
HERE ARE TEN GREAT REASONS TO SELECT THE INDUSTRY'S BEST, THE TURBO-COOL™ 300 AND TURBO-COOL™ 450.

1. 50% TO 100% MORE POWER

The more power, the better! Our high-capacity units start drive motors with ease, run cooler, last longer, and allow for future expansion.

2. BUILT-IN LINE CONDITIONING

Turbo-Cool power supplies won't skip a beat when the line voltage sags. Their wide input range (85-135V, 170-270V) and heavy-duty input components protect your PC and its data from sags, surges and spikes.



3. FCC-B AND VDE-B LINE FILTER

A dual-stage EMI filter keeps electrical noise well below agency standards.

4. INDEPENDENT REGULATION

Turbo-Cool's superior independent-regulation design keeps output voltage tolerances 20 times tighter than that of an ordinary power supply. This exceptional stability improves hard drive reliability during critical access periods.

5. ULTRA-CLEAN DC OUTPUT

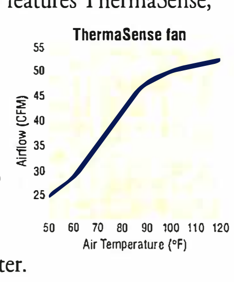
A dual-stage output filter ensures that sensitive computer chips receive pure, low-ripple power.

6. PROTECTION CIRCUITRY

Our units offer the most complete protection from dangerous overvoltage, overcurrent, and short circuit conditions.

7. THERMASENSE™ COOLING FAN

The Turbo-Cool 300 features ThermaSense, our high-capacity, thermostatically-controlled, variable-speed fan. It's ideal! High-performance systems operate up to 35° cooler while standard ones run as much as 75% quieter.



8. UL/CSA/TUV APPROVALS

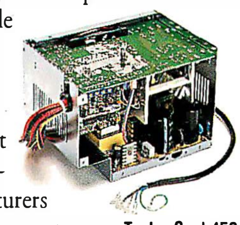
Our high-capacity units are safety approved by not only UL, but also by Canada's CSA and Germany's strict TUV.

9. TWO-YEAR WARRANTY

Turbo-Cools are designed and tested for MTBFs of over 100,000 hours. They come with a no-hassle 2-year warranty and a 30-day money-back guarantee.

10. GREAT VALUE

Loaded with premium features, a Turbo-Cool power supply will upgrade the performance of your PC or LAN file server at a retail cost of only 55¢ to 80¢ per watt. You'll be powered by a unit that is popular with award-winning PC manufacturers and recommended by experts such as the PC Magazine Advisor!



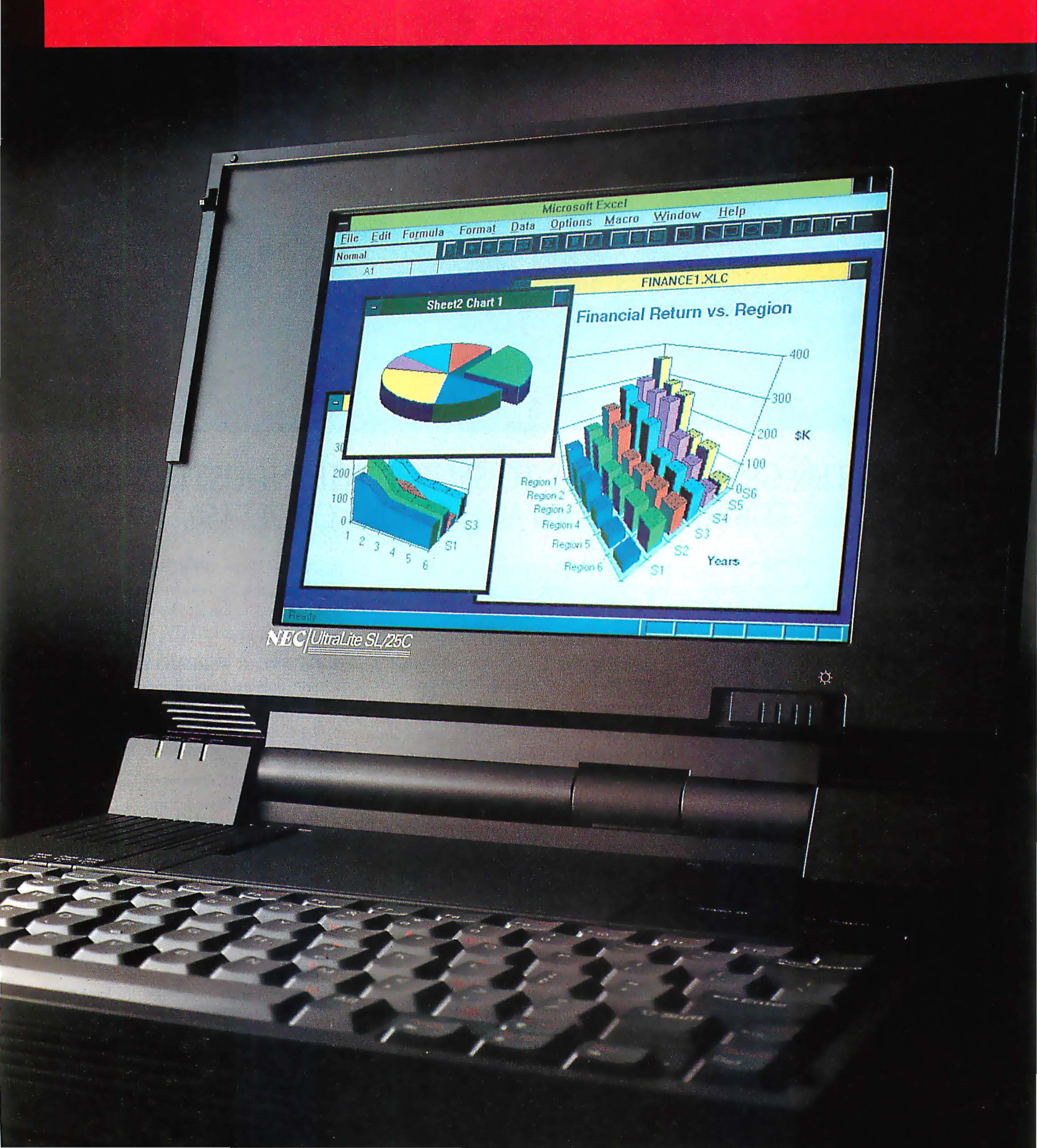
Turbo-Cool 450

PC POWER & COOLING, INC.

5995 Avenida Encinas, Carlsbad, CA 92008 • (619) 931-5700 • (800) 722-6555 • Fax (619) 931-6988

Circle 101 on Inquiry Card (RESELLERS: 102).

Introducing the be
notebook co



st color display in a mputer. Ever.

In its review of our UltraLite® SL/25C notebook, *PC Magazine* said, "NEC is about to make the future of portable computing a whole lot brighter."

We couldn't agree more.

The best color display in a notebook. Ever.

The fact is, NEC is the first to offer an active-matrix TFT color screen in a notebook, and yet, in the words of *PC Magazine*, "its price tag rivals lower-quality passive-matrix offerings."

What's the difference between active-matrix and passive-matrix color screens? One looks vivid, sharp and bright, like your desktop monitor. The other doesn't. One can be viewed from wide angles. The other can't. One is clearly the future of notebook computing. The other isn't.

The best processing technology in a notebook. Ever.

To quote *PC Magazine* once more, our SL/25C "has more going for it than just spectacular color. It's also one of the first notebooks to use Intel's new 25-MHz 386SL chip set."

The new chip provides all the processing punch of a 386 desktop PC. Offers intelligent power management for longer battery life. And runs even the most complex applications at blazing speed. The 7.5 lb. SL/25C comes standard with 2MB of RAM (expandable to 10MB), an 80MB hard disk, internal floppy and 64KB cache. As well as MS-DOS® 5.0 and Windows™ 3.0, loaded and ready to run.

Just what exactly is active-matrix TFT display anyhow?

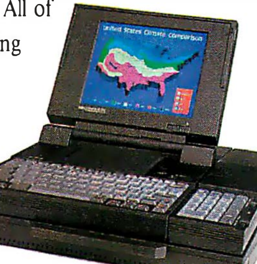
Active matrix TFT (thin-film transistor) display means that for each pixel on the screen, there is a tiny transistor. In the case of the SL/25C, that adds up to over 900,000 transistors covering the entire screen, forming the image. With each pixel controlled by its own transistor, the image is always in sharp focus, and far brighter than other screen designs permit. NEC has long been a world leader in display technology. And the SL/25C is one example of this.

It does everything a powerful desktop does. Except chain you to a desk.

There's a serial port, SuperVGA CRT port, PS/2® mouse port and optional internal modem. An enhanced parallel port allowing improved throughput for network connections. And an optional full-function, portable Docking Station™ unit—with two expansion slots and a 3.5" drive bay—that not only turns the SL/25C into a desktop you can take anywhere, it also gives you other options, like fully integrating sound and image to create your very own portable multimedia platform.

A powerful argument for color, right here in black and white.

It also has a brilliant VGA display. A palette of over 225,000 colors. A fast screen refresh rate (so you never lose your cursor). And a "simultaneous video" feature—so the image you see on your screen can also be viewed on an external video device, like a big-screen projector. All of which makes one thing perfectly clear: the SL/25C is truly the ultimate presentation tool.



Shown with optional Docking Station.

Call today.

For more details, call 1-800-NEC-INFO. Or call NEC FastFacts at 1-800-366-0476, #ULSL25C (8575252). In Canada, call 1-800-343-4418.

We'll give you enough information about the SL/25C to make you not want to be without it. Ever.





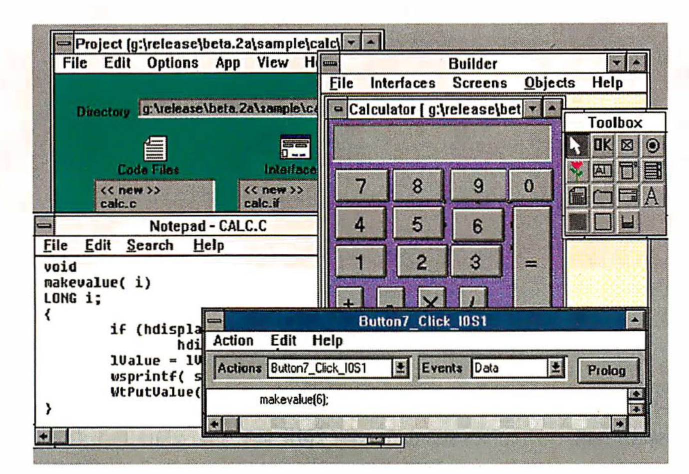

is the way you want to go.



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Multiplatform Applications with Objects

WinTran uses a system of named visual objects, such as text, lists, images, or tables, rather than windows, to develop multiplatform GUI applications. The WinTran application code is written in standard programming language but is not tied to any particular windowing model. WinTran treats visual objects uniformly across GUI platforms, so you can port their associated applications across Windows, OS/2, Macintosh, OSF/Motif, and other platforms.
Price: Windows version, $495.
Contact: Guideware Corp., 2483 Old Middlefield Way, Suite 224, Mountain View, CA 94043, (415) 969-6851; fax (415) 969-3862.
Circle 1299 on Inquiry Card.



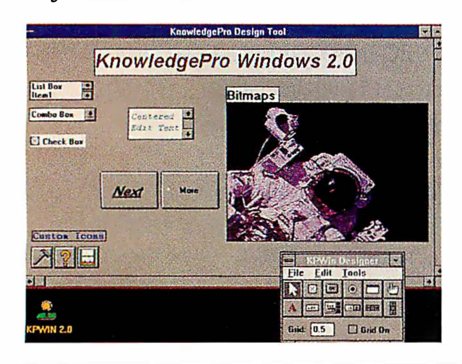
WinTran's Project Manager consolidates all the application elements and presents a visual map of the project as it develops. The Builder window on the right provides tools for building interface screens without your having to switch back and forth between programs.

Knowledge Garden Upgrades Its OOP Tool

Version 2.0 of the KnowledgePro Windows (KPWin) object-oriented programming environment features improvements to its design tools, dynamic link library (DLL) access, and Multimedia Extensions support.

The upgrade lets you use objects such as combo boxes or buttons by selecting them from a library, dropping them into a window, and applying attributes like size, color, and font. KPWin automatically generates alterable corresponding code. You can link your objects to external DLLs via one-line commands. This DLL support lets you access all the commands in the Microsoft Multimedia Developers Kit, the company reports.

Knowledge Garden also offers the KPWin SVW Video Toolkit, an add-in toolkit for controlling motion video in real time. The Video Toolkit works with New Media Graphics' Super VideoWindows overlay board.
Price: KPWin 2.0, $249; SVW Video Toolkit, $299.
Contact: Knowledge Garden, Inc., 12-8 Technology Dr., Setauket, NY 11733, (516) 246-5400; fax (516) 246-5452.
Circle 1300 on Inquiry Card.



The KnowlegePro Windows visual design tools come with source code. You can generate code interactively, amend it, and then feed it back to the design tool.

Link and Swap Memory with Blinker 2.0

Said by its developer to be the only linker offering an integrated memory-swap function, Blinker performs linking and dynamic overlaying of programs written in Microsoft C, Zortech and Borland C++, and many other languages. Blinker 2.0 can also dynamically overlay the Microsoft BASIC PDS 7.1 development system. Blinker's memory-swap capability lets you use expanded or extended memory to save an executing program and then shell out and run a second program from within the first.
Price: $299.
Contact: Blinkinc, P.O. Box 7154, Richmond, VA 23221, (804) 355-4444; fax (804) 355-1676.
Circle 1301 on Inquiry Card.

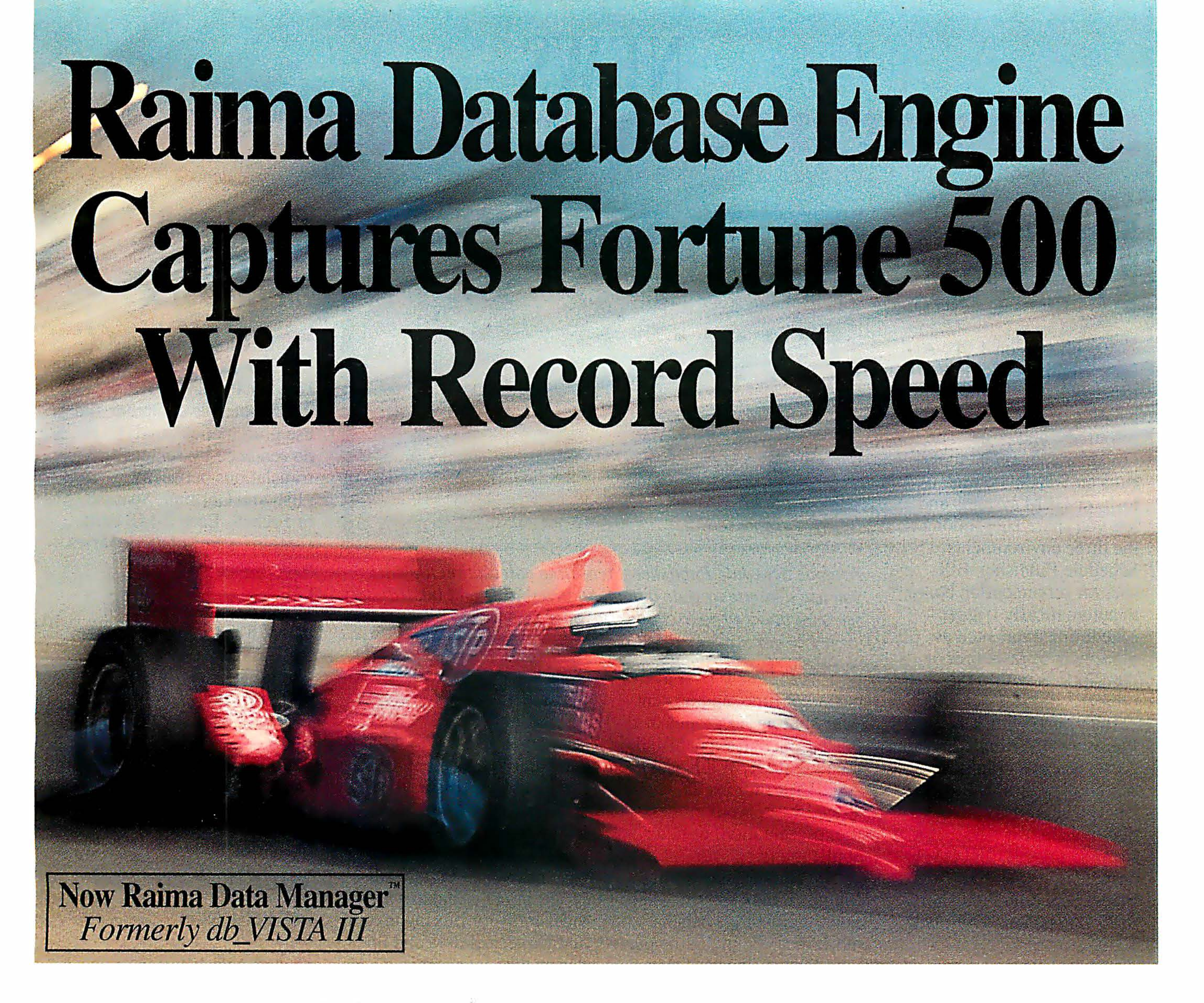
Add Neural Networking to Windows

NeuroWindows lets you incorporate neural networks into your applications. Release 2.0 adds real-time execution of supervised and unsupervised learning processes. The library lets you incorporate up to 128 neural networks within a single program. A driver that provides support for the company's NeuroBoard (a RISC-based board for speeding up network training time) is included in release 2.0.
Price: NeuroWindows, $369; NeuroBoard, $2000 to $3100, depending on configuration.
Contact: Ward Systems Group, Inc., 245 West Patrick St., Frederick, MD 21701, (301) 662-7950; fax (301) 662-5666.
Circle 1302 on Inquiry Card.

A Video Library for C and BASIC

LiveWindows lets you write your own video-based applications in C or BASIC. The LiveWindows library lets you scale captured NTSC or PAL video to any size and display it in an on-screen window. The program lets you place VGA text or graphics on your live or frozen video.

The LiveWindows library is available for a variety of languages and compilers. A motion video board and VGA card with feature connector are required.
Price: $395; $995 with video board.
Contact: Software Interphase, Inc., 82 Cucumber Hill Rd., Suite 140, Foster, RI 02825, (800) 542-2742; fax (401) 397-6814.
Circle 1303 on Inquiry Card.



Accelerated Database Performance

Compared to conventional relational databases, retrieval of records can be 10---20---even 50 times faster with Raima Data Manager from Raima Corporation.

Propelling The Biggest Names In Business

Companies like General Motors, Hewlett-Packard, IBM, Eastman Kodak, Rockwell and others are using Raima Data Manager in their competitive environments. Today's most critical, most demanding applications demand the high performance of Raima Data Manager.

Powerfully Efficient Leading-Edge Technology

Raima's combined technology merges the flexibility of relational databases with the lightning speed and efficient storage of the network model. With the program written entirely in C, you can "fine-tune" the Raima Data Manager engine for optimum performance in any application.

Put Yourself In Fast Company

Give yourself the competitive edge of Raima Data Manager:

- Speed—faster access to data
- Portability—supports most environments
- Royalty-free—increase your profits
- Source code availability—total programming flexibility
- Full Raima support services—including training

Whether you're writing a stand-alone DOS application, or one for UNIX accessing thousands of records, Raima Data Manager will put your application on the fast track. Race to the phone and call for more information!

Raima Data Manager™

The High Performance DBMS

In the U.S. or Canada, call: 1-800-DB-RAIMA

In Washington state or international, call: **(206)747-5570**

Specifications Relational B-tree indexing. Network data model. Relational SQL query and report writer. Single & multi-user. Automatic recovery. Built-in referential integrity. **Supports:** VMS, QNX, ULTRIX, UNIX System V, Berkeley 4.2, AIX, SunOS, SCO, MS DOS, MS Windows, and OS/2. **Most C Compilers and LANs supported.**

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BY42RC

Share Windows, Mac, or GEM Scheduling Data

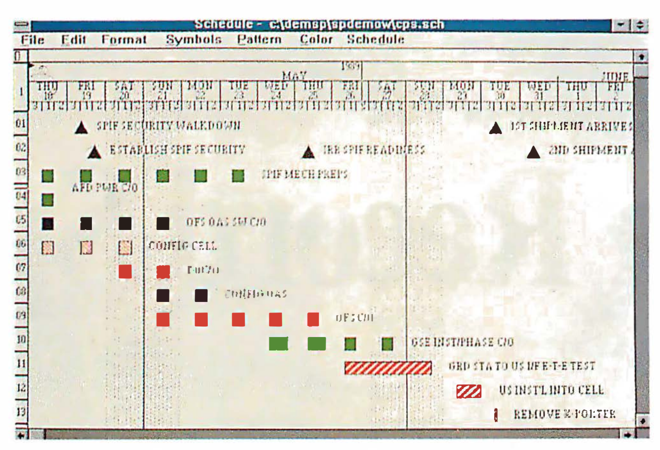
With version 4.0L, Artemis Schedule Publisher offers real-time calculation of schedules, resources, and costs. The project management tool runs on Windows, Macintosh, or GEM systems and lets you share files among the three environments. Schedule Publisher 4.0L uses on-screen option boxes to automatically trigger scheduling data, such as placement of resources or descriptions within the project.

Integrated with Schedule Publisher is Artemis Presents 2.0A, Lucas's graphics presentation program. Presents lets you compile reports that include text files, scanned images, and CAD drawings.

Price: Schedule Publisher, $1995; Presents, $995; both, $2495.

Contact: Lucas Management Systems, Inc., 12701 Fair Lakes Cir., Suite 350, Fairfax, VA 22033, (703) 222-1111; fax (703) 222-8203.

Circle 1304 on Inquiry Card.



Artemis Schedule Publisher's real-time calculation tools let you use a mouse to slide a particular resource and immediately see the impact of your change on other resources.

Financial Finesse with Mutual Fund CD-ROM

Now you can be your own broker by using Morningstar Mutual Funds OnDisc to evaluate, compare, and track more than 2200 mutual funds. The CD-ROM package contains a database of front-load, no-load, equity, and fixed-income funds. You can use fund data in conjunction with the program's searching and graphing capabilities to select funds and plot them against each other, compare returns for funds over a period of time, and present your findings as graphs or reports. You can export fund data via PCX, WK1, and ASCII files for use in spreadsheet, word processing, presentation, or other applications.

You can measure your Mutual Funds OnDisc selections against nine benchmark indexes, including the Standard & Poor's 500. The program includes a history and complete portfolio for each fund. In many cases, Morningstar provides information acquired directly from the fund manager.

Price: Subscription with annual update, $295; with quarterly update, $495; with monthly update, $795.

Contact: Morningstar, 53 West Jackson Blvd., Chicago, IL 60604, (312) 427-1985; fax (312) 427-9215.

Circle 1305 on Inquiry Card.

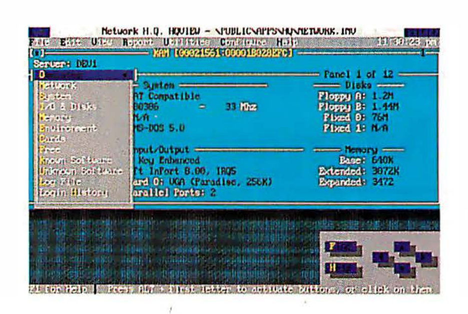
All-in-One Mac Office Software

HandiWorks combines a word processor, a spreadsheet, a basic drawing program, page layout tools, and an address database in a single Macintosh program. The package provides tools for linking textual and numerical data and updating that data within a document. You can import and export ASCII, Microsoft Word, MacWrite, and WriteNow files. HandiWorks supports a variety of graphics file formats. Using Claris's XTND filters, HandiWorks can exchange files with other word processors and spreadsheets.

Price: $175.

Contact: MacVonk•USA, 313 Iona Ave., Narberth, PA 19072, (215) 660-0606.

Circle 1306 on Inquiry Card.



Using Network H.Q., the network administrator can collect and update key workstation files such as CONFIG.SYS or WIN.INI.

Translation Program for HP 95LX

The Globalink Translation ROM cards run on Hewlett-Packard's HP 95LX portable computer and use grammatical analysis to do sentence-by-sentence translations between English and German, Spanish, or French. Each 2-MB card contains a pair of dictionaries with more than 50,000 terms.

Price: $299 per language pair; $815 for one pair and the HP 95LX.

Contact: Globalink, Inc., 9302 Lee Hwy., Fourth Floor, Fairfax, VA 22031, (800) 255-5660 or (703) 273-5600.

Circle 1307 on Inquiry Card.

Survey Your Networked Hardware

Network administrators can now use Network H.Q. over a variety of networks to track workstation configurations. Version 2.0 runs over NetWare, Microsoft LAN Manager, Banyan Vines, and Hayes Lan/Step NOS networks and identifies PC model numbers, chip-set data, and other hardware information. According to Magee Enterprises, the H.Q. utility will survey Macs connected to your network. Network H.Q. also surveys software on both the server and workstation internal drives.

Price: $395 for 100-workstation license; $595 per server with unlimited users.

Contact: Magee Enterprises, Inc., P.O. Box 1587, Norcross, CA 30071, (404) 446-6611; fax (404) 368-0719.

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Open new windows with TI microLaser™ printers.



And get powerful fonts and graphics, ease of use and more speed than ever.

By now you've heard how fast and easy Microsoft® Windows™ makes it to tap all that PC power you've got on your desk.

Well now there's an affordable, easy way to put that power on paper — microLaser from Texas Instruments.

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When it comes to print speed, the new microLaser Plus zips along at 9 ppm. If you need a shared printer solution, turn to the 16 ppm microLaser XL.

If all that isn't enough, just look at what else you get with microLaser. It's the smallest printer in its class. It handles more paper and envelopes in more ways. And it supports more than 4,000 software packages, including your Windows applications.

So when you add it all up, you'll understand why the power of your ideas needs the power, convenience and economy of microLaser. Let microLaser open new windows for you.

For the name of the nearest dealer, call

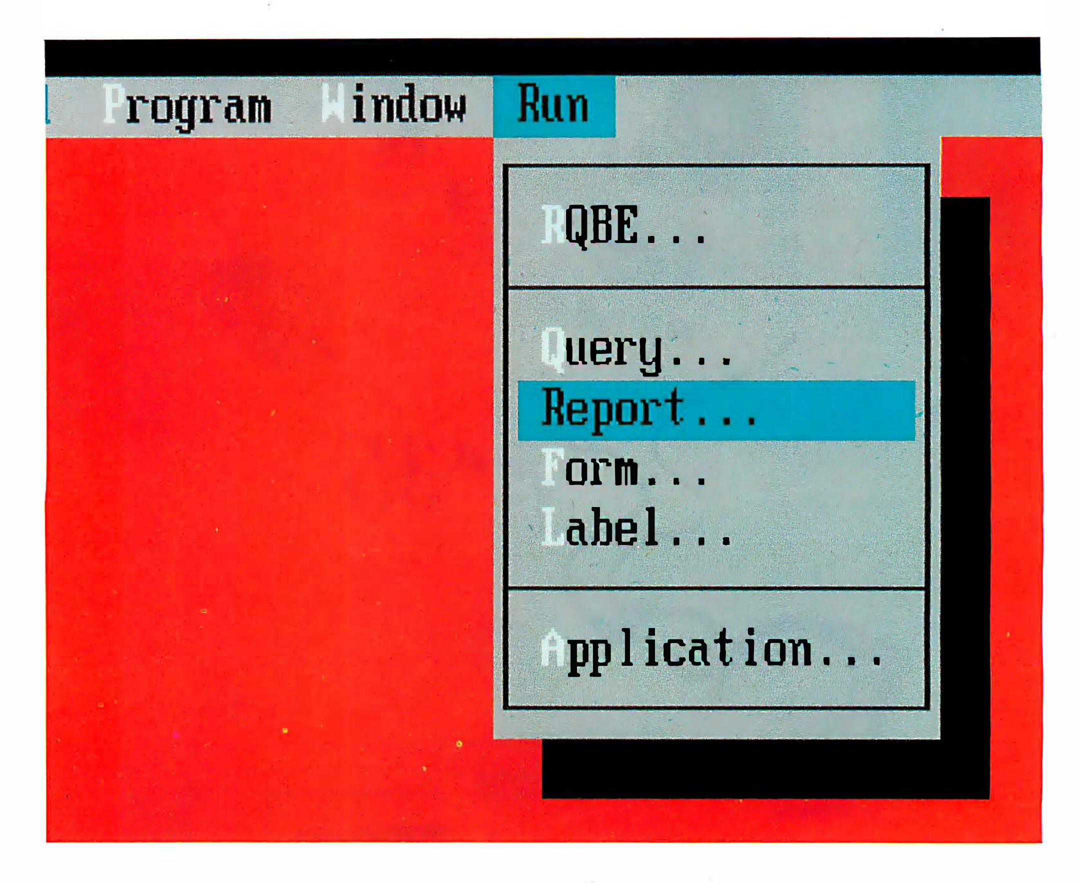
1-800-527-3500.



*TI suggested retail price. (Dealer prices may vary.) microLaser is a trademark of Texas Instruments Incorporated. Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems, Inc. © 1991 TI 71860

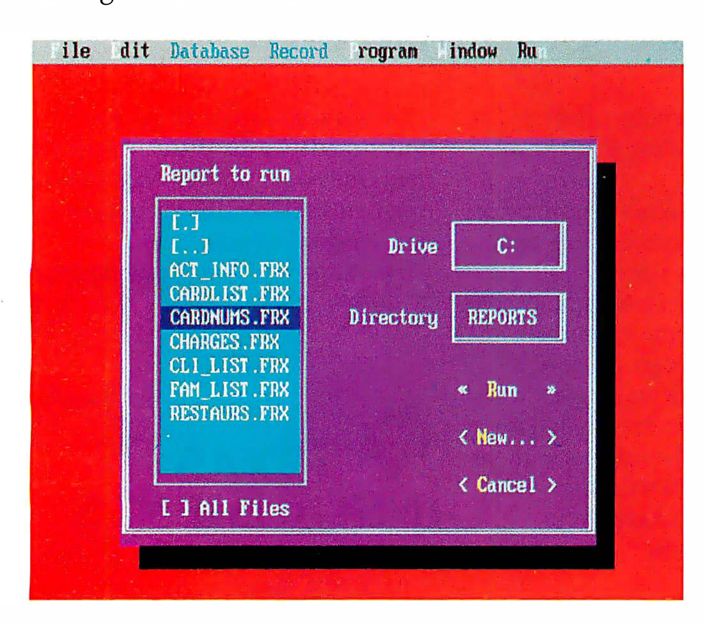
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See Fox *RUN.*



We've just added a new word to the database vocabulary: *RUN.*

And it can make you a master of your database management universe. Even if you've never managed a database before.



The most powerful PC DBMS available is now the easiest to use, too: FoxPro™ 2.0.

Pick *Run* from the FoxPro 2.0 main menu and you have instant access to your information. Click on *Report*, choose the name of the report you want, and it's yours. Do the same for queries, forms, labels and applications.

For answers on-the-fly, pick *RQBE* (Relational Query By Example) and get a simple interface for creating custom queries quickly and easily. Unlike other query systems, RQBE lets you browse the information or create instant databases, reports, labels, or business graphs (with optional FoxGraph or other graphic program).

Custom systems are easy, too.

You create quick reports, forms, labels and applications by clicking on the *New* button in the dialog box instead of picking a name from the list.

Then using our simple tools, you build forms containing buttons, lists, check boxes, text regions and data fields. Reports with headers, footers and

subtotals. And even complete applications.

All without any programming.

So while it's the most powerful DBMS you can get today, it's ideal for small businesses and large. In industry or government. For invoicing and inventory control, order entry and accounting, and all your data handling needs.

FoxPro is the state-of-the-database-art.

FoxPro 2.0 is the object-oriented, event-driven DBMS programmers have been waiting for, too.

We've added over 100 new and enhanced commands. 4GL (Fourth Generation Language) tools for creating screens, reports and menus as reusable application objects. And the ability to attach entry and exit procedures to fields, forms and windows for pre- and post-processing.

We've integrated SQL SELECT, UPDATE and CREATE TABLE into the language, with the ability to use RQBE for creating SELECT statements you just cut and paste into your application code.

We've added a project manager on top of our debugger, trace window, and editor.

We provide an Application Program Interface (API) that links to C or assembler function libraries (Library Construction Kit optional).

And we offer an optional Distribution Kit to distribute your applications royalty-free.

Today's best choice for upgrading or downsizing critical database applications.

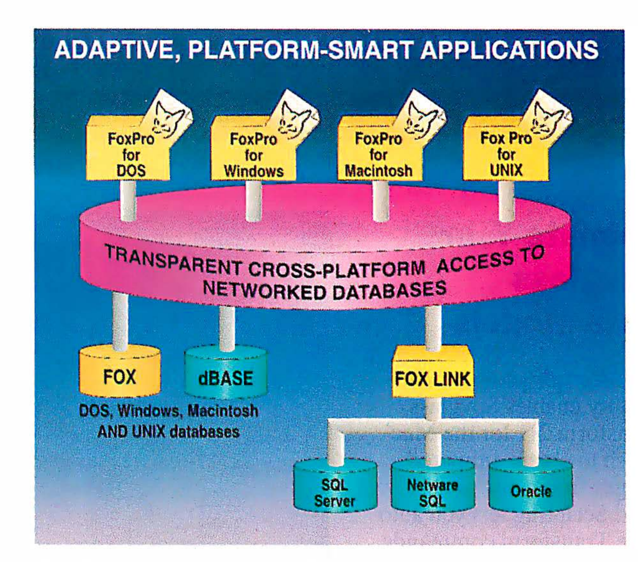
FoxPro is devastatingly faster than competitive products (see chart† – the difference is even greater in single-user tests), and has out-queried even mainframe databases like Oracle, XBD and DB2, using our patent-pending Rushmore™ query optimization.

FOXPRO 2.0 = 19
Multi-User Relative Speed
PARADOX = 2
dBASE IV = 1

No one comes close to FoxPro's multi-user query response.

It's backward compatible with dBASE III+/IV and earlier versions of Fox software to protect your investments in hardware, software, training, and support.

And in the few months since its release, FoxPro 2.0 has swept the awards. Best DOS Application - *Spring COMDEX*. Technical Excellence -*PC*. Award of Excellence -*Byte*. Best DBMS -*Data Based Advisor*. And many, many others from both editors and users of FoxPro 2.0.



Applications developed today with FoxPro for DOS, unlike other databases, will be able to run under Windows and SCO/UNIX and on the Macintosh when we release our new versions of FoxPro later this year.

Get a headstart on tomorrow today.

Today, FoxPro exchanges data with FoxBASE+ on Macs and on PCs running SCO UNIX. Later this year, FoxPro will be available for Windows, UNIX, and the Mac, all with access to Netware SQL, SQL Server, and Oracle databases.

And applications written using FoxPro's 4GL tools will be platform-adaptive, so DOS or Windows applications will run on UNIX or the Macintosh, and vice-versa.

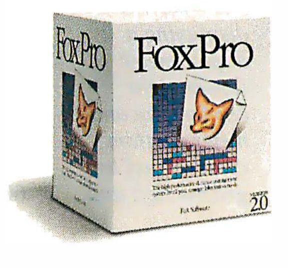
Which means you can get a headstart on your future by starting your Windows, Mac or UNIX development now with FoxPro on your current DOS PCs.

It comes with a 60-day money-back guarantee.

So pick up a copy of FoxPro 2.0 at your nearest computer or software store. Try it out for 60 days, then if you don't like it, just return it to your dealer for a full refund.

But we think you'll agree with Byte magazine in their 1/92 review of dBASE: "...FoxPro is the better product."

Call 1-800-837-FOX2 today.
(419-874-0162 from Canada)
Ask for Lit Pak BYT401





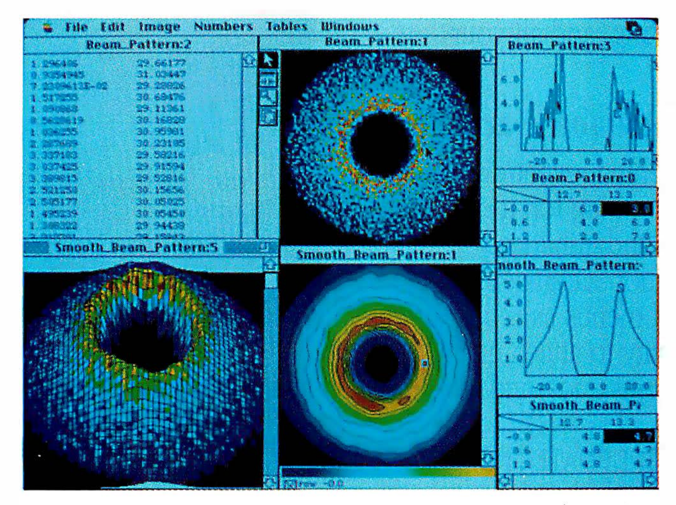
†Query benchmark tests performed by Micro Endeavors, Inc. (215) 449-4680, from Data Based Advisor 8/91.

Circle 70 on Inquiry Card.

Animate Your Spyglass Data Models

A new scripting capability enables Spyglass Transform 2.1 for the Macintosh to create animated images from your plotted data. Scripting lets you automate Transform commands and batch-process your 2-D data files. Because the program accepts Apple events, you can run Transform commands from other applications. The template feature lets you save Transform commands performed on one data set and execute them later on another data set. According to Spyglass, the program performs five to 10 times faster than the previous version.

Transform 2.1 lets you control orientation, axis location, and labeling. You can run plot animations as PICS, HDF, or PICT sequences.
Price: $495.
Contact: Spyglass, Inc., 701 Devonshire Dr., C-17, Champaign, IL 61820, (217) 355-6000; fax (217) 355-8925.
Circle 1309 on Inquiry Card.

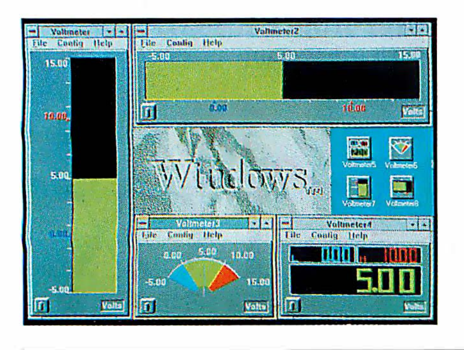


You can scale Spyglass Transform colors to represent actual numeric values.

Turn Your Monitor into a Meter Display

PCImeter lets you display analog data onscreen as digital and analog meters and bar graphs. You can run up to 16 meters simultaneously, and you can set high and low alarm points for each meter. If you so desire, PCImeter can be configured to trigger digital outputs as your data reaches the setpoints. You can save meters to your PCImeter application files and reconfigure them at any time.

PCImeter runs under Windows 3.0 or higher. The program acquires data for analysis via an Intelligent Instrumentation I/O board, and it can export the results to Microsoft Excel spreadsheets using Dynamic Data Exchange.
Price: $95.
Contact: Intelligent Instrumentation, 1141 West Grant Rd., MS 131, Tucson, AZ 85705, (602) 623-9801; fax (602) 623-8965.
Circle 1310 on Inquiry Card.



PCImeter, here displaying a digital meter (lower right corner), an analog meter (bottom center), and bar graphs (left and top).

Math Modeling with Expanded Graphics Tools

Matlab 4.0 merges numeric computation software with application-specific tools and graphics capabilities to provide a mathematical modeling tool with a variety of analytical functions. Enhancements to the X Window System program include sparse matrix support, support for data import and export via any arbitrary file format, and sound output.

Version 4.0 provides tools for analyzing and visualizing data, as well as optimizing engineering system designs and algorithms. You can use Matlab 4.0 to create mathematical models, solve systems of equations, and perform general computations. The program lets you create and animate 3-D graphs using rectangular, spherical, and general parametric coordinate systems.

Matlab 4.0 is available for the Sparcstation; Hewlett-Packard 900/300, 400, and 700; IBM RISC System/6000; DECstation Ultrix; and Silicon Graphics workstations.
Price: $2995.
Contact: The MathWorks, Inc., Cochituate Place, 24 Prime Park Way, Natick, MA 01760, (508) 653-1415; fax (508) 653-2997.
Circle 1311 on Inquiry Card.

Develop and Plot Systems of Equations

With VisSim for Windows, you can turn the most convoluted equation into a sensible data model. VisSim lets you build flow-chart-style programs from data blocks and connect the blocks with function-performing FlexWires. Once you've developed your program (e.g., for representing the cycles of a bouncing ball or the flow of blood in the human body), VisSim plots it against a time element. Version 1.1 lets you alter your data model by using a slider control to adjust the source data.

You can save your VisSim models as screens and export them to Windows applications such as WordPerfect. The program lets you import and export ASCII data files, and you can print your models on all Windows-supported output hardware.

VisSim lets you build model programs that contain up to 16,300 data blocks. Visual Solutions also offers a personal version with a 255-block limit. The company recommends using a math coprocessor with VisSim.
Price: Professional version, $895; personal version, $190.
Contact: Visual Solutions, Inc., 487 Groton Rd., Westford, MA 01886, (508) 692-5499; fax (508) 692-3102.
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Voice*
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Introducing the amazing new SupraFAXModem™ V.32bis! On the fax side, it has 14,400 bps send and receive fax, Class 1 and 2 commands, and compatibility with the millions of Group 3 fax machines in use. On the data side, it connects at 300 to 14,400 bps and provides up to 57,600 bps throughput with V.42bis compression. (It has MNP 2–5 and 10, too.) Plus its revolutionary display gives you 25 different status reports! And for just a little more, you can easily add caller ID and voice capabilities later this year. In addition to the $399.95 stand-alone version (without software), SupraFAXModems are available in Windows™, DOS™, and Macintosh™ packages.





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* Low-cost, user-installable Voice & Caller ID upgrades available Q2 '92.

Circle 171 on Inquiry Card.

View AutoCAD Files on Your Sparcstation

Drawing Librarian for Sun lets you view and make notes on AutoCAD, DXF, and slide files. You can access AutoCAD drawings on your Sparcstation via Sun's Open Look interface or use Drawing Librarian to convert DWG files to DXF.

Using a menu of drawing commands, Drawing Librarian lets you mark up CAD images and save the notations in a separate file. The program's functions include zoom and rotate, and you can display blocks, layers, and other AutoCAD information. Drawing Librarian supports AutoCAD versions up through release 11.

Price: $1000.

Contact: SoftSource, 301 West Holly St., Bellingham, WA 98225, (206) 676-0999; fax (206) 671-1131.

Circle 1313 on Inquiry Card.

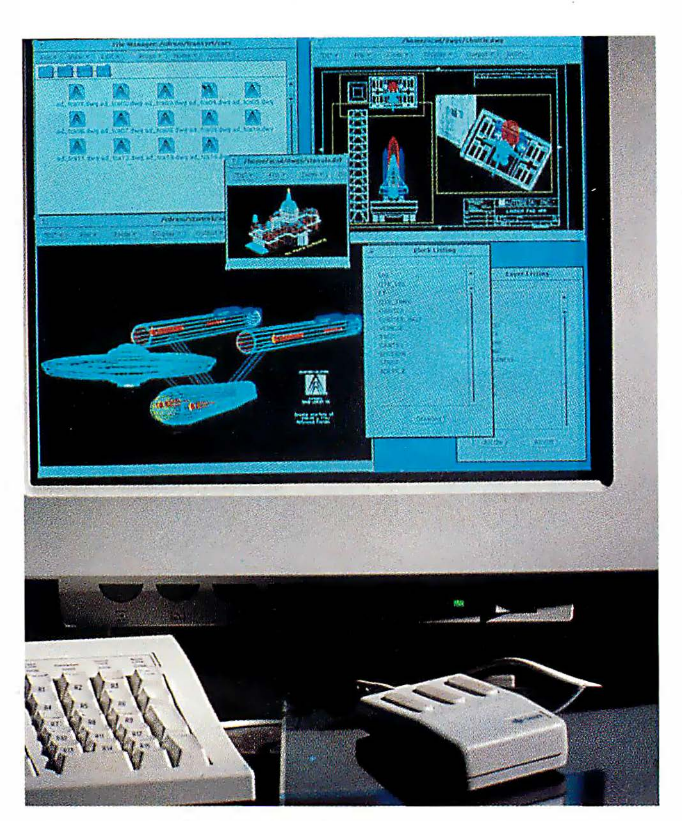
FreeHand Upgrades for Mac and Windows

Upgrades to the Aldus FreeHand design program are available for Windows and Macintosh environments. FreeHand 3.0 for Windows lets you access tools and layers via floating palettes. You can also use the Windows upgrade to draw and edit in full-screen color preview mode. FreeHand 3.1 for the Mac offers a pressure-sensitive capability for use with freehand drawing tools. The program fully supports System 7.0 and offers new file import and export options.

Price: $595 each.

Contact: Aldus Corp., 411 First Ave. S, Seattle, WA 98104, (206) 628-2320.

Circle 1314 on Inquiry Card.



Drawing Librarian lets you view and add notes to files faster than with AutoCAD, SoftSource reports.

Graphing and Presentation Tools for Mac

Version 1.5 of DeltaGraph Professional offers System 7.0 support and more than 40 styles of business and scientific charts. DGP lets you import text and graphics data via WKS, PICT, and other filters, Publish/Subscribe, or a direct link to Microsoft Excel. Once you import your data, you can plot it as a column, pie, or other business chart or as a scientific chart (e.g., a time line, spider, or bubble). Charting options include scatter, surface, and true 3-D *x*, *y*, *z* surface plots.

DGP lets you create unlimited libraries in which to store custom-formatted charts, clip art, or other items. The Slide Show feature lets you present charts from the screen as printouts or as screen captures. Slide Show offers 32 slide transition effects.

Price: $295.

Contact: DeltaPoint, Inc., 2 Harris Court, Suite B-1, Monterey, CA 93940, (408) 648-4000; fax (408) 648-4020.

Circle 1315 on Inquiry Card.

SPREAD THE WORD

Please address new product information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Better yet, use your modem and mail new product information to the microbytes.hw or microbytes.sw conferences on BIX. Please send the product description, price, ship date, and an address and telephone number where readers can get more information.

A Multitude of Tools for AutoCAD

With version 5.0 of ASG Core, you can now apply a wide variety of tools and utilities to AutoCAD applications. The program contains a hierarchical layer manager, a scheduling manager, a cost-estimating interface, menu and text file editors, Advanced Modeling Extension menus, full metric and imperial support, compatibility with NetWare and other networks, and other features.

Price: $495.

Contact: ASG, 4000 Bridgeway, Suite 309, Sausalito, CA 94965, (415) 332-2123; fax (415) 332-2146.

Circle 1316 on Inquiry Card.

Scan Text and Graphics with OmniPage

OmniPage, for Macintosh systems, automatically separates text from graphics and lets you scan any document, regardless of the number of typefaces or columns. OmniPage's optical-character-recognition tools let you process text at rates of up to 2000 words per minute. The Verification Window lets you edit a scanned document while simultaneously viewing a bit-mapped image of the original page.

Other features include the ability to recognize and correct upside-down scans, correct interpretation of similar-looking characters, and System 7.0 support.

Price: $995.

Contact: Caere Corp., 100 Cooper Court, Los Gatos, CA 95030, (408) 395-7000; fax (408) 354-2743.

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We put it all on the table. The 20MHz DECpc 320P Notebook Personal Computer is the most comfortable to use on the market today, while the components inside are the hottest. We started with the Intel™ 386sx™ processor and the built-in 2400 baud modem (optional data/FAX modem). Because we don't believe you should have to sacrifice power for portability.

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Storage:	40MB IDE Hard Disk Drive 3.5″ 1.44MB Floppy
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Modem:	2400 bps Data
Keyboard:	84-key Keyboard
Mouse:	Logitech TrackMan Portable
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0 (factory installed)

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The **DEC**pc 316sx



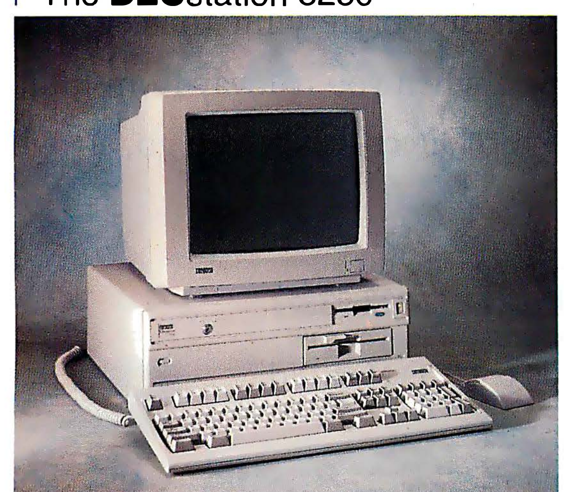
Includes:

Microprocessor:	Intel i386sx running at 16MHz
Memory:	1MB, 80ns Memory Kit
Storage:	52MB IDE Hard Disk Drive 3.5″ 1.44MB Floppy
Resolution Mode:	1024 X 768 SVGA Adapter
Display:	14″ Multi-sync VGA Color Monitor
Keyboard:	101-key Keyboard
Mouse:	Three-button Mouse
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0

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The **DEC**station 325c



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Microprocessor:	Intel i386 running at 25MHz
Memory:	4MB, 80ns Memory Kit
Storage:	52MB IDE Hard Disk Drive 3.5″ 1.44MB Floppy 1.2″ dd Floppy
Resolution Mode:	1024 X 768 SVGA Adapter
Display:	14″ VGA Color Monitor
Keyboard:	101-key Keyboard
Mouse:	Three-button Mouse
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0

Special Package Price **$2,179**
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THE PACKS.

The **DEC**pc 320P Notebook



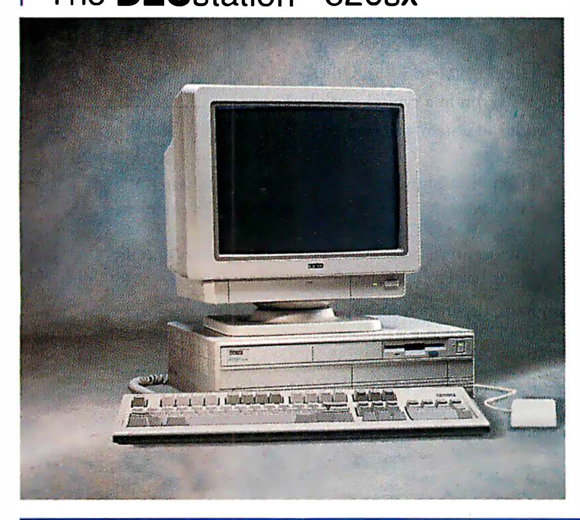
Includes:

Microprocessor:	Intel i386sx running at 20MHz
Memory:	2MB
Storage:	80MB IDE Hard Disk Drive 3.5″ 1.44MB Floppy
Display:	TST Backlit VGA
Modem:	2400 bps Data
Keyboard:	84-key Keyboard
Mouse:	Logitech TrackMan Portable
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0 (factory installed)

(Carrying case included)

Special Package Price **$2,495**
FR-PCP11-FA

The **DEC**station™ 320sx



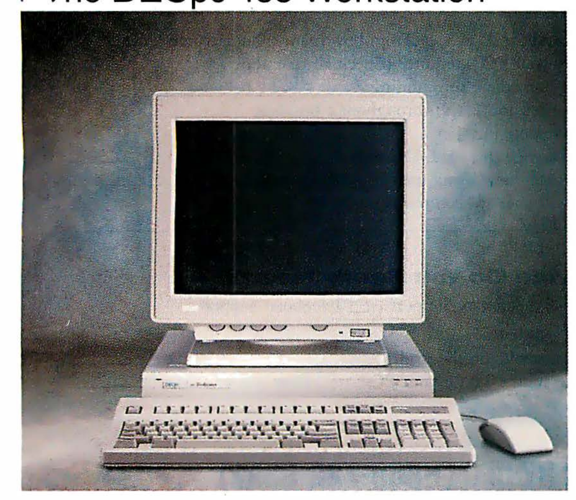
Includes:

Microprocessor:	Intel i386sx running at 20MHz
Memory:	1MB, 80ns Memory Kit
Storage:	52MB IDE Hard Disk Drive
Resolution Mode:	1024 X 768 SVGA Adapter
Display:	14″ Multi-sync VGA Color Monitor
Keyboard:	101-key Keyboard
Mouse:	Three-button Mouse
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0

Special Package Price **$1,849**
DJ-PC443-05



The **DEC**pc 433 Workstation



Includes:

Microprocessor:	Intel i486 running at 33MHz
Memory:	8MB, 70ns Memory Kit
Storage:	40MB IDE Hard Disk Drive 3.5″ 1.44MB Floppy
Resolution Mode:	1280 X 1024 TIGA Adapter
Display:	20″ Color Monitor
Keyboard:	101-key Keyboard
Mouse:	Three-button Mouse
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0

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- ☐ DECpc i486 and i486sx based systems
- ☐ The DECpc 320P Notebook
- ☐ The Catalog

Customization Worksheet

Your base system is a: ☐ 286 ☐ 386 ☐ 486 ☐ Other

How many applications will your PC(s) run in a typical workday? ____________

What best describes the type of work the system will be used for? (Check all that apply).

- ☐ Word Processing
- ☐ Order-entry
- ☐ Database (filing records)
- ☐ Financial Calculations
- ☐ Retail Store Management
- ☐ Desktop Publishing
- ☐ Education
- ☐ Design (CAD/CAM)
- ☐ Engineering
- ☐ Industrial Process Control
- ☐ Scientific Research
- ☐ Software Development
- ☐ E-Mail
- ☐ Other industry-specific applications (please specify)

How many people work in your group, department or small business?
☐ Less than 10 ☐ 10-20 ☐ 20-35 ☐ More

Is your operating system:
☐ DOS ☐ DOS with Windows ☐ OS/2 ☐ MAC ☐ UNIX™ ☐ Other

Which of the following graphics-oriented applications best describes your needs? (Check all that apply)

- ☐ Desktop Publishing
- ☐ CAD/CAM
- ☐ Realtime Modeling
- ☐ Animation
- ☐ Image Processing
- ☐ AutoCad
- ☐ Business Graphics

LAN Communication

How many PCs do you have installed? ________ From how many manufacturers? ________

What kinds of connections does your PC(s) require? (Check all that apply)

- ☐ Links with other PCs in the immediate surroundings
- ☐ Connection to the local area network (LAN) throughout a building
- ☐ A line to a host system in a remote location

What kind of media (cable) is used in your LANs today? ____________

What is the networking software now being used in your company? ____________

What kind of host system will your PC communicate with?
☐ DEC ☐ IBM ☐ Other ____________

What Kind of Service Do You Really Need?

☐ On-site Hardware Support ☐ Software Support ☐ Telephone Support
☐ Training ☐ FAX Hotline

How many of your users take portables on the road? ____________

Do you currently have a service contract(s) for your PCs? ☐ How many? ____________

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A. What is your primary job function/principal area of responsibility? (Check one.)
1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

☐ *Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.*

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Inquiry Numbers 1-493

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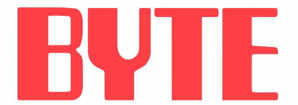
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5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1-25
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20 ☐ 51-99
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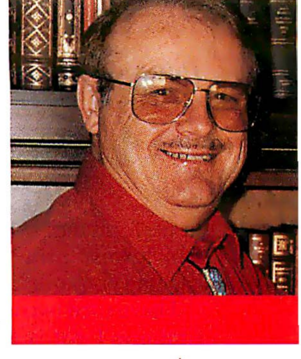
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JERRY POURNELLE

USER'S CHOICE AWARDS

It's that time again. Unlike some people, I don't give my annual awards until the end of the year, which means it is now time for the 1991 User's Choice Awards and the Chaos Manor Orchid and Onion Parade.

Two cheers for IBM for not releasing OS/2 2.0 in 1991. They advertised that it will be a better DOS than DOS and a better Windows than Windows, and no matter that it's been coming Real Soon Now for quite a while, they're not going to ship it until it works properly. I can agree with that decision.

Two cheers for Bill Gates for delaying the release of Windows 3.1 and announcing Windows NT (New Technology) years before it will ship. Meanwhile, out here in User Land, we'd just like something stable that works and won't give us unrecoverable applications errors....

Three cheers and an orchid for AMD and their 386 chip, which has sent the prices of 386 systems tumbling, and for developing a 40-MHz 386 chip. Two cheers to the Taiwanese clone makers who advertise systems as "Intel Inside" and then in small print tell us they're using AMD chips....

User's Choice

I began the annual User's Choice Awards on a whim. This was long before everyone else began giving awards. It was also during the early days in the computer industry, when there weren't many products that *deserved* awards. I conceived it as part of my job to drive the computer industry in directions I thought would be best for users. The awards, as well as the onions and orchids, were designed to further that end, and they've had some success.

The trouble is that I began with the wrong approach, because I wanted to give awards for "the best of the year." That wasn't bad in the early days, when I really could look at most of the major items in any given category, but now it's often plain ridiculous to pretend that I have looked at everything significant. Worse, though, is how do I choose when several products are more than good enough?

Sometimes, though, a product will stand out so much that there's little doubt, and I have no hesitation in calling it the top product in its field. When that happens, I'll say so. But do understand that just because some product stands out alone doesn't mean that it's "better" in some absolute sense than another wonderful product that has to share the glory with a competitor. Good enough is good enough, and that's how User's Choice Awards should be taken. By designating a product as User's Choice, I'm saying that if you need its capability, you won't be sorry you bought it.

The rules here are simple: I don't recommend anything I have not personally used long enough to have confidence in. I discuss these decisions with my BYTE editorial colleagues, and BYTE helps distribute the certificates, but the User's Choice Awards remain my sole responsibility. Blame me, not BYTE....

Upgrading Your System

Probably the best upgrade you can buy for your DOS system is a caching drive controller. Caching is a means of anticipating what data your computer will want next and putting that data where the machine can find it fast. For example, all caching systems keep the disk directory and file allocation table in cache memory so that the computer doesn't have to physically access the disk to find out where to get or store a file. After that the caching programs vary, although all of them use some kind of "most used, last discarded" algorithm.

One way to get the benefit of caching is to add more memory and use one of the better software caching programs (e.g., Vcache from Golden Bow Systems or even the SMARTDRV.SYS that comes with Windows). However, those programs just add to the work load of your CPU and bus, and they tie up memory you could be using for other things.

By contrast, caching controllers have an on-board CPU, so you're doing true multiprocessing. They have algorithms at least as good as the software-only caching programs and caching memory on the controller card. The result is a dramatic improvement in performance: reads and writes go much quicker than under straight DOS or DOS with a software cache, and you still have all your expanded memory. Moreover, you can save system memory. I have not been able to see any difference

The annual Orchid and Onion Parade at Chaos Manor

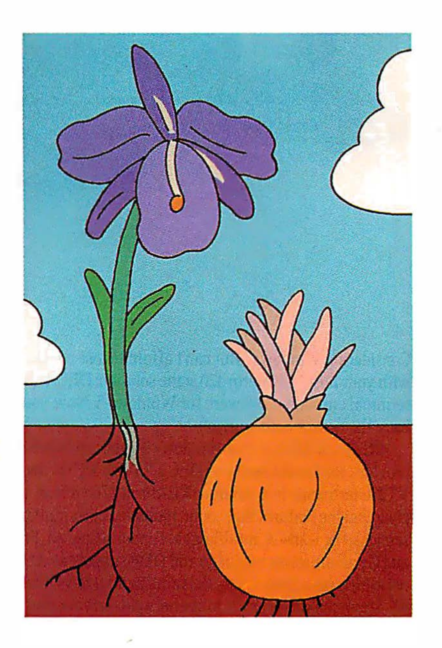


ILLUSTRATION: STEVE TURK© 1992

in performance with or without buffers, which wasn't true prior to my getting a caching controller.

I have used two caching controllers. The first one I got is from Distributed Processing Technology, the PM2011/90 for SCSI hard drives. (I also have their PM3011/70 for ESDI hard drives.) The other one is the HyperStore 1600 from Perceptive Solutions, Inc. They both work splendidly. I have to work hard to devise tests that will show any performance advantage to either one. One test I have is a big matrix inversion that repeatedly stores intermediate results on the hard disk. Caching controllers typically save about 50 percent of the 5 minutes the program requires when running with a noncache controller, and the difference in time for the controllers from DPT and PSI is negligible.

Both these controllers are easily installed. Each company has SCSI and ESDI controllers. PSI has configuration modules for other types of drives, so if you have such a drive, your choice is clear. Otherwise, you simply have to go on brand loyalty and price.

Moreover, both PSI and DPT controllers have modes to let you use just about any old drive you have available. PSI has a way to add on several different *kinds* of physical drives and run them all at once through add-on modules known as *media adapters*. This could be useful if you have, say, a SCSI drive and an IDE drive and want to use both in the same machine. Both PSI and DPT controllers have ways of making your machine believe you have an AT-compatible hard drive, no matter what it really is; they will also let you use the latest and greatest hard drives and software. Both companies have excellent technical support. Although it isn't needed for simple installations, it can be important as soon as things get tricky.

I've been writing about both companies for three years, and I have received no reader complaints against either. DPT is a bigger company and has been around longer. Their products cost more, and they use proprietary memory cards. PSI has been steadily gaining market share in the last two years and has been around long enough that I'm sure they'll be here for a while. PSI charges less and uses standard SIMMs for memory.

In a word, both companies are plenty good enough. I am pleased to award DPT and PSI User's Choice Awards for 1991 for their caching controllers.

Video Boards

Windows with old and slow video is nearly intolerable. If you want to switch to Windows, it's imperative that you get a fast video board. The improvements are dramatic. Our friend Steve Allen Mitchell, a Unix workstation guru, has to work with Windows off and on. He was recently introduced to a 486 with an ATI Technologies Graphics Ultra video board and said, "That's as close to a workstation as a PC is going to get."

Unfortunately, pure speed is not enough: there are boards out there that are plenty fast enough, but whose BIOS hogs memory the board doesn't really need. It's important to get a board that works properly with Windows, yet allows you to use good memory managers; and it's important to get that board from a company that understands driver software.

I have had half a dozen video-board companies recommended to me. I'm sure they're all good, but I can recommend only what I use myself. Do understand, I have tested these only under Windows, not under the X Window System or Unix.

For Windows, the two video boards and

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Dick Patefield, Senior Project Manager for Store Systems Support, JCPenney

Recently JCPenney Co., Inc. changed its operations from the old POS systems to the new PC-based technology, relying on PC platforms for point-of-sale and in-store support. And they back each one up with help from MINUTEMAN.

"There was a violent surge in one of our stores," says Patefield. *"If we didn't have the MINUTEMAN unit, it probably would have seriously damaged all of our point-of-sale equipment.*

"The key was the switch-over time from AC to battery," says Patefield. *"It really has the best continuity of the UPS systems we evaluated. Also, the price was very favorable. When you're installing them in as many locations as we are, the pricing was very attractive."*

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video software that I currently recommend are from ATI and Sota Technology. Both boards are easy to install, the physical board and software drivers. The documents are complete and easily understood, and technical support is good. I'm pleased to give the ATI Graphics Ultra and the Sota Lightning VGA my 1991 User's Choice Awards.

Printers

For many years, we have had one of the very first Hewlett-Packard LaserJet printers ever made. It was eventually refurbished as a LaserJet Plus and became The Printer That Would Not Die. Over the years, I came to dislike certain features, particularly the fact that it stacked the paper face-up, meaning that a book came out with its pages in the wrong order. It was also difficult to insert letterhead. It wasn't particularly fast, although compared to the Diablo daisy-wheel printer it replaced, it certainly was.

All that was mere grousing, though; that printer was wonderful. It worked year after year—never in the shop, never out of service, always there when I needed it. I turned out thousands of letters and a dozen or more books on that printer.

It still works and is in use at a church school. But this year I replaced it with a LaserJet III, and once again I'm in love. If you need a real workhorse printer, one good enough for most office work, the LaserJet III is more than just good enough; it's outstanding. It's easily installed. There are dozens of fonts for it (it uses all the font cartridges from my old LaserJet I), and nearly every software package provides drivers for it. It's fast, it's designed so that it's easy to insert letterhead or print envelopes, and it's very reliable.

I have no hesitation in giving the LaserJet III a User's Choice Award as the most useful printer of 1991.

The LaserJet III does have resolution limits, although they aren't severe. As I detailed in a previous column, Jim Baen was able to do the final typesetting of *Go Tell the Spartans* by Pournelle and Stirling using the Baskerville typeface, Ventura Publisher, and a LaserJet III to produce masters that were then photoreduced to make the printing plates. However, that book was an all-text paperback printed on typical paperback paper; this process would not have been good enough to do the typeset masters of a larger-format book on slick paper.

For that kind of resolution, I recommend the LaserMaster TrueTech 1000. This produces 1000-dot-per-inch resolution output with well-shaped letters. The LaserMaster algorithms for increasing printer resolution appear to be better than HP's trick for accomplishing that. Indeed, I see no reason why LaserMaster output couldn't be used to master any book I have, regardless of size, typeface, and paper stock. Let me hasten to add that I don't pretend to be the final authority on typesetting, and if you're contemplating doing high-resolution print masters, you probably want to spend some time researching the situation.

I do know that the LaserMaster TrueTech 1000 produces aesthetically pleasing copy. Moreover, unlike the phototypesetter it can often replace, the LaserMaster doesn't require nasty chemicals, and, also unlike most phototypesetters, it's extremely reliable. If you need high resolution, you'll be happy with the LaserMaster TrueTech 1000. It gets a User's Choice Award in the Very High Resolution Printer category.

File Conversions

There's always a need to convert files from one format to another. It's especially true when changing over to Windows, but since I use Q&A Write, hardly a week goes by when I don't get a file in a format different from that of my word processor. When that happens, I rely on Word for Word from Mastersoft to convert the file, and that usually works.

I say *usually* for accuracy; I'm not trying to be hard on Word for Word. The problem is that there are a lot of file formats out there, and some of them use some obscure tricks. It would be surprising if everything worked the first time every time. I've used a lot of file-conversion programs, and the one that has worked consistently best has been Word for Word; moreover, they keep updating it, and each revision is an improvement.

I'm not 100 percent satisfied with the program: I wish there were better "intelligent ASCII" conversions for use on files pulled off-line, and once in a while I get some odd glitches when converting to Q&A Write format. But it's still the best conversion program I know, plenty good enough to win a User's Choice Award.

Windows vs. Desqview

I can't decide. I have used Desqview for years, and I'm comfortable with it. Desqview with a 386 machine is so superior to DOS that until Windows 3.0, I couldn't imagine using anything else—and it's indispensable for 286 systems. It's true that you have to fuss a bit with Desqview, but even that's much simpler now that Quarterdeck has revamped the installation program. Desqview works and works well, and I'm used to it, so I can jump from word processor to notebook to telephone book to diary to communications program simply and easily, and I generally have no problems at all.

Alas, it's not *fun*, while Windows is. I confess it: I like being able to customize my start-up screen. I like wallpaper, and flying toasters are fun, and so is having a Gary Larson Far Side cartoon come up with my calendar page on start-up. I like having silly little customized icons. I can even offer the intellectual defense that seeing all those icons on my computer desktop reminds me that they're there, just as having books all around me in my office reminds me of things I read long ago. Then, too, there really are some Windows programs that are so good that it may be worth buying Windows to be able to run them. I'll get to those in a minute. The point is, there's a lot to like about Windows.

Alas, there are a couple of things to hate, too. The one I hate most is that Windows is far more likely to crash than Desqview, and when it does, it's likely to crash utterly and completely, requiring a hardware reset and certainly losing any unsaved work.

In fairness, I have to say that I never install and try a new application in either Windows or Desqview without saving everything first, so the amount of work I have actually lost due to Windows crashes is small to nonexistent. Also, the time lost to having to go through hardware reset is probably made up by the fact that it's generally faster and easier to install a DOS program under Windows than to get it right on Desqview. I also have to say that Desqview used to crash fairly often, and I stuck with it, and I'm not sorry.

The programs that crash Windows have generally been games. Some of them, like Strategic Studies Group's Warlords, will run under Desqview but crash Windows.

continued

But I have to confess that I seldom play games under either Windows or Desqview, so the problem would seem more theoretical than real—but the theoretical problem is that if that game will crash Windows, what else will? And once in a while I get some very mysterious glitches, but I'm pretty sure they're specific to the Windows 3.1 update and will be fixed before you read this.

Alex points out that you can run Windows under Desqview; that way, you run all the DOS applications as Desqview applications and all the Windows applications in Windows. What you get that way is standard-mode Windows, but the practical effect of what enhanced mode really does is memory-address checking, and the combination of QEMM and Desqview does that better and faster anyway. Even so, it feels like a kludge, and I'd rather not have to run two different environments, particularly when I'm testing new software.

The gripping hand, as Moties are wont to say, is that if Windows hasn't quite become good enough, it won't be long before it gets there. While I will keep Desqview and use it when necessary, I expect the switch to Windows to be done by the end of this year. Therefore, the User's Choice Award for Operating Environment of the Year goes to Microsoft Windows.

Memory Management

I like Windows, and clearly I recommend that if you don't change to Windows, you should run Desqview. Either way, you'll need a memory manager; fortunately, the same one works for both. It used to be that QEMM and Windows had some problems, but no longer. Now they work together just fine. Moreover, installing QEMM-386 6.02 is a snap, and so is optimizing for either Windows or Desqview. As an example, we are looking at a Tandy 4033LX multimedia machine. It comes nicely integrated with Windows and CD-ROM and DOS extensions; the only problem is that as it comes, it has DOS windows of 530 KB. We installed QEMM and let the Optimize program do its thing; we now have 630-KB DOS windows on that machine.

I've looked at a lot of memory managers this year, and I have no trouble at all choosing Quarterdeck's QEMM-386 6.02 as the User's Choice for Best Memory Manager of 1991.

Windows 3 Secrets

If you use Windows, run, do not walk, to your nearest bookstore and get Brian Livingston's *Windows 3 Secrets.* Read the first four chapters, and I guarantee that you'll then know more about Windows than almost anyone you know. This book explains in clear language just what Windows is doing, what it's trying to do, and what its programmers thought they were trying to do.

It explains undocumented features. It interprets the Windows error messages, including those that imply precisely the opposite of what they seem to be saying. It explains what standard mode is, and why you probably want to use it even though you have a 386 system. It tells you how to make Windows save your desktop without exiting and restarting (i.e., open a DOS application and attempt to leave Windows with the "save on exit" switch on; Program Manager will inform you that there are open applications, but before it finds that out, it has saved the current desktop). It tells you what the "About Program Manager" display in "Help" means (and it's nothing to do with help at all).

Finally, the book comes with two disks of shareware Windows programs that will make your life a lot easier.

I don't care how many Windows books you already have; get this one. If you have this one, it's not likely you'll need any other. *Windows 3 Secrets* hands down wins the User's Choice Award for the Best Windows Book of 1991.

Ascend

The Franklin Time Management System is one of the best known of the paper and notebook time management systems. It's usually presented in a 4-hour seminar that teaches and motivates you to use the tools. Of course, some people find all that unpleasant and aren't interested in time management systems and tools. I've even heard a few call the system inflexible. I don't see it that way. I find the Franklin system a useful way to organize my work and set priorities on what I want to accomplish.

Ascend is a Windows implementation of the Franklin system. It comes with forms and notebooks to hold the calendars and schedules that the program generates, a software implementation of the Franklin system, and tapes and workbooks that present the Franklin seminar about as you'd get it if you attended in person. The result is that you have everything you need to change your life.

Now, if you don't need to have your life changed, this program isn't going to do much for you. Some people are well organized and don't need any help. Others are hopelessly disorganized, and it's possible that this won't help them because they like being the way they are. For the rest of us, the Franklin system offers some hope.

Franklin is a bit different from its rival

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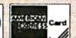
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Day-Timer, because the essence of the Franklin system has to do with setting priorities and goals. But the schedules and calendars that Franklin generates are fairly similar to those in a Day-Timer. I used to carry a Day-Timer everywhere I went, but I found that I wasn't able to coordinate between information gathered on the road and the home-base calendar. Ascend uses the computer to do much of that coordinating for you.

If you've been hoping to find something that would let your computer help organize your life, this program may be it. In any event, it gets a User's Choice Award for Windows Applications Software.

The Far Side

The Far Side Computer Calendar won't change your life. It's just a good Windows-based calendar program. On the other hand, it's fun, with a different Larson Far Side cartoon every day and some animations done by Larson himself.

It has the standard features of a calendar, with schedules and alarms and suchlike, and it will print them out in reasonable formats. But you wouldn't buy it for that since there are shareware programs that do as well. The Far Side Computer Calendar gets an orchid because it's *fun*.

Database Applications

For ordinary flat-file database applications, we use Q&A. There's a new version, 4.0, that fixes most of the annoyances of earlier versions and makes several improvements, including adding mouse support. Do understand, the problems we've had with Q&A have been minor annoyances, not major aggravations. Q&A remains the easiest database to learn and use that we know. A technoklutz can sit down in front of a Q&A screen and be building database forms within an hour; within a week, he or she will be able to do Christmas cards and print the labels, handle inventories, log in receivables, and generate reports.

Q&A Write is similarly easy to learn as a word processor, and it's powerful enough for anything I need: I write all my books and columns with it. Indeed, I recently installed Microsoft Word for Windows, and while it's elegant and has many features Q&A Write will never have, it didn't take long before I installed a Q&A Write icon and brought that up in Windows. I suppose someday I'll learn Word for Windows, but what's the hurry?

Flat-file databases may not be enough. You may need a really powerful full relational database. Most people don't. One of these days when I don't have to cover a zillion awards, I'll devote a chunk of the column to examining when and why

New QEMM-386 v6.

There's no better way to manage your memory.

> **"It's nothing less than a dream come true"**
> —*Steve Gibson InfoWorld 8/26/91*

Suddenly PC users have a lot of memory managers to choose from. Seems that everyone has figured out what users have been telling us for years: they need every last 'K' of available memory between 640K and 1 megabyte—especially if they're running on a network. Or using TSRs.

Our new QEMM-386 version 6 is the best way to get the most out of memory. It 'pools' all your memory so that it's available in whatever form your programs need—expanded or extended. You don't even need to know the difference. QEMM does it all for you. Instantly. Whereas DOS 5, for example, requires you to figure out what you need, then manually allocate memory and re-boot every time you need to change.



As for the all-important 'conventional' memory area, our new version 6 increases the amount of memory freed-up. Our exclusive 'optimize' feature automatically seeks out TSRs and device drivers and moves them into high memory—the area between 640K and 1 megabyte. All you need do is type 'OPTIMIZE'.

#1

QEMM is the number one selling PC utility.

QEMM-386 v6 finds more high memory than any other memory manager. *Byte Magazine's* tests showed it produced net memory gains of 21K to 132K over DOS 5.0 alone, for instance.

What you can expect
Automatic High Memory Gain Comparison

DOS 5 alone | DOS 3 or 4 | DOS 5 — with QEMM-386 v6

Stealth takes you to network and TSR heaven.

Our breakthrough 'Stealth' technology makes available areas normally taken up by ROM. Areas that QEMM-386 can use to load memory-hogging drivers and TSRs. Big programs can get the memory they need to run fast and efficiently. And you get to have your TSRs.

Not every PC can benefit from Stealth. But every PC can benefit from *'Squeeze'*—our new feature to manage those TSRs that need more memory at start up and less when they're resident. Memory allocation is temporarily increased, then squeezed down after it's needed.



QEMM can use idle video memory to produce a further 96K gain on EGA and VGA systems when running character-based programs.

A priceless $60 bonus.

QEMM comes with Quarterdeck Manifest, the award-winning analysis program that makes it easy to see what's going on 'under the hood' of your PC.

See and understand how your PC works with Manifest.

Manifest does for memory what PC Tools Deluxe does for disks.

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Whether you're running DOS 3, 4, 5, or Windows, QEMM can improve your 386/486's performance.

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you need a full relational database. In any event, if you do need one, I recommend Borland's Paradox, which is relatively easy to set up and is certainly powerful enough.

For Windows, though, you want an object-oriented database. For the moment, the best one of those I've seen is Bell Atlantic's Thinx, which I talked about in a past column. It's clever, the tutorial is sufficient for learning it, and it gets easier to use with practice. It's certainly powerful enough for most user needs.

I'm happy to give Q&A 4.0 and Thinx the User's Choice Awards for Best DOS and Windows Applications, respectively.

Clip'nSave

Several readers nominated this for an orchid. Clip'nSave makes it easy to capture Windows screens, save them in a BMP file, and convert them to different formats. There are detailed instructions on making your own wallpaper and a lot of information on bit-map formats and how they work. It has the disconcerting feature of mucking up your desktop when you install it, but a quick trip to the control panel will fix that, after which you've got a great utility.

There's one problem. I've found a few conflicts between this and Windows 3.1. I suspect, though, that by the time you read this, the problems will be taken care of. In general, the readers are right: this deserves an orchid.

Trantor

I think of Trantor as a new company, but in fact, they've been around since CP/M days. They've since gone over to being specialists in SCSI. Their best-known product is the T338 MiniSCSI Parallel-to-SCSI Host Adapter, which enables you to use SCSI devices—CD-ROM drives, optical drives, and Bernoulli Boxes—with a portable computer. They also make Micro Channel SCSI boards and other stuff, and they're continually improving what they do; it's a company well worth watching.

A Chaos Manor orchid to Trantor, and a User's Choice Award to the T338 MiniSCSI Parallel-to-SCSI Host Adapter.

System of the Year

I like Windows and big 486 systems, but as time goes on, I get more and more attracted to Apple's Mac way of life. I had little use for the original 128-KB Mac, which I thought was an overpriced toy, but that was a long time ago. Since then, Macs have been greatly improved, and I note that many users who don't know or care what's going on inside a computer are able to sit down at a Mac and get a lot of work done.

One defect the Apple system had until this year was the lack of a decent portable. But that has been fixed with the PowerBooks.

Apple's System software was elegantly integrated, but MultiFinder did odd things and unexpectedly brought down the system at very inconvenient times. That, too, was remedied this year.

A large orchid to Apple: System 7.0 is great, and the Mac Quadra 900 is wonderful. I don't count it a defect of the Quadra 900 and System 7.0 that some older software won't run properly: Apple has been telling people for years that you must not write self-modifying code. Apple's programming standards are published and clear, for which Apple deserves yet another orchid. Two cheers for shipping machines like the Quadra 900 and the Mac Classic II with only 2 MB of memory when System 7.0 takes up more than half of that, but that's a minor quibble.

I think that the Quadra 900 and System

Before You Upgrade To MPC, Listen To This.

BYTE

USER'S COLUMN

Sound Blaster
One of the boards we installed in the Arche 486 was Sound Blaster. With its associated software, it has quietly (no pun intended, but what the heck) become the standard sound system for advanced PCs. The Roland board has much higher sound quality for a higher price, but for anything short of professional music quality, Sound Blaster is good enough.

There are lots of other accessories you can get for Sound Blaster, including musical instrument software and a voice editor. Sound Blaster has become the standard sound board, if not for the industry, at least here at Chaos Manor. Recommended.

Jerry Pournelle

 GAMES

SOUND BLASTER PRO

By Barry Brenesal

The Marines may look for a few good men, but any PC game player will gladly settle for a single good sound card: one that plays both Sound Blaster and AdLib scores, one that doesn't fry your other boards, one that never draws attention to itself, one that delivers all the sophisticated sound effects and music bundled into the latest batch of game software.

Look no further: Sound Blaster Pro does it all, and more. At $299.95 it's not cheap, but neither are its features.

Testing: One, Two . . .

Installing Sound Blaster Pro is a snap. The 16-bit card slips easily into place. It comes with a

Trying out Sound Blaster Pro is a treat. It's got great frequency response — that's the difference between listening to a film score on a tinny, muffled AM radio and hearing it on a stereo movie-theater speaker system. The orchestral soundtrack to Origin's Wing Commander is a good example, because it changes mood and melody to match the success of your current battle. Add Sound Blaster Pro to a good VGA screen and a responsive joystick (which you can plug into Sound Blaster Pro's joystick port),

and the illusion of dogfighting aliens in a George Lucas-style film becomes 3-D, symphonic reality.

Another plus is the absence of the annoying background hiss

In short, Creative Labs' Sound Blaster Pro is a big winner. It's quick to install, easy to use, full-featured, and compatible with Sound Blaster and AdLib files. Signal response is excellent. And don't forget

COMPUTE

SNEAK PEEKS

SOUND BLASTER PRO

In just two years, the Sound Blaster has become one of the of the most widely-supported PC sound cards. It's easy to see why. The Sound Blaster contains an 11-voice FM synthesizer that makes it fully compatible with the popular Ad Lib Music Card. The day it hit store shelves, the Sound Blaster could be used with hundreds of Ad Lib compatible games and educational programs. To add even more value, the original Sound Blaster included a DAC (Digital to Analog Converter) for digitized voice and sound effects, a microphone jack for voice input, a built-in game port, a built-in 4-watt amplifier, and an optional MIDI interface.

The built-in mixer makes the Sound Blaster Pro fully compliant with Microsoft's Multimedia Level 1 Extensions to *Windows*. Multimedia software will be able to fade-in, fade-out, and pan the various audio sources to create elaborate sound montages.

The Sound Blaster Pro includes a CD-ROM interface for either an internal or external CD-ROM player.

There's also an internal connector for CD-Audio. The MIDI interface is compatible with the original Sound Blaster's MIDI interface, but adds the MIDI time-stamp that's part of Microsoft's new multimedia standard.

All in all, the Sound Blaster Pro is chock-full of new features, yet it's fully compatible with its younger brother.

DAVID ENGLISH

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PC HOME JOURNAL

Sound Blaster Does It All

Review by Harvey Bernstein

The Sound Blaster has so many audio applications packed into one half-sized board that it almost boggles the mind. First, it has an 11-voice stereo music synthesizer that is fully compatible with the widely used AdLib sound format. Older software that only supports the AdLib board will automatically turn on the AdLib mode — no adjustment by the user is necessary. A separate channel is exclusively for reproducing digitized speech. A microphone jack on the back of the card allows you to digitize your own input voices. With a 4-watt stereo amplifier built in, you can run speakers or headphones directly from the card — no additional amplification is necessary. A standard joystick port also doubles as a MIDI interface, allowing you to connect a synthesizer or any other MIDI instrument. Combine this with an excellent library of software, and it is easy to see why the Sound Blaster has become so popular.

...is the Sound Blaster worth the investment? Yes, yes, a thousand times yes!!! When you hear how much the Sound Blaster increases the capabilities of your PC, you'll wonder how you ever got along without one.

Now you can get the number one sound card as part of our new Multimedia Upgrade Kit. Which also comes with a MIDI kit, an internal CD-ROM drive and 5 CD-ROM titles, including Microsoft® Bookshelf® and Windows™ with Multimedia Extensions. In all, $2,000 worth of goodies for just under $850.

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CREATIVE LABS SOUND BLASTER PRO



Creative Labs, Inc., 2050 Duane Ave., Santa Clara, CA 95054 Telephone: (408) 986-1461 Fax: (408) 986-1777 For international information, fax Creative Technology at (65) 773 0353. Sound Blaster is a registered trademark of Creative Labs, Inc. Windows and Bookshelf are registered trademarks of Microsoft Corporation.

Circle 154 on Inquiry Card.

7.0 are a giant step forward for computer users and now set the new standard for productivity—as well as being a lot of fun to use. The Chaos Manor User's Choice Award for Machine of the Year goes to the Quadra 900.

Portable Computers

This was the year I abandoned my back-breaking Zenith 386SX portable. It's not that it isn't a great machine; indeed, once I get to my destination, I sometimes wish I had brought it for the large bright screen and big keyboard. On the other hand, I don't miss lugging 20 pounds of computer, case, power supply, and accessories while racing from gate to gate to catch an airplane.

This year, I tried a number of portable machines and one palmtop. I found that I'm too set in my ways to make much use of a palmtop, but my son Phillip uses a Poqet every day. He's a Navy officer and has found the little machine invaluable and rugged enough for his needs. He does advise that you get rechargeable batteries and a recharging device, since his early version of the Poqet uses up penlight batteries like mad.

I used about a dozen notebook computers this year, and two stood out: the Safari NSX/20 and the TravelMate 3000 WinSX from Texas Instruments (TI).

We've taken them both all over the country. The TravelMate bounced around in the Bronco while we drove down to Baja for the eclipse, and the NSX/20 traveled with us to Tahoe for the Hackers' Conference and then down to Las Vegas for Comdex.

The TravelMate is preferable as a general-purpose DOS and sometimes Windows machine, largely because the ROM character set is more aesthetically pleasing. It's also better for Desqview users because it is able to use QEMM's Stealth technology to get larger windows.

The NSX/20, on the other hand, has wonderful provisions for communications and does Windows extremely well. Also, it is a more handsome—and handy—unit. I especially like the battery arrangement that lets you change batteries on the fly.

In a word, they're both good enough. What's happened is that Roberta, who still prefers Desqview to Windows, has taken over the TravelMate. She now carries it in preference to Toshiba-san, the Toshiba T1000 she's had for many years. Given that the TravelMate weighs about twice what the T1000 does, that's quite a concession. That leaves the NSX/20 for me, which works out well because I'm working hard at getting used to Windows; also, I do much more communications, including faxing, when I'm on the road. What I really like is that TI and Safari Systems aren't the only companies working on improving laptop computing.

I'm pleased to give User's Choice Awards to the TravelMate 3000 WinSX and the Safari NSX/20.

Logitech TrackMan Portable

Safari considered the Microsoft Ballpoint mouse, which was my previous favorite choice for a pointing device for portables, but chose the Logitech TrackMan Portable trackball to bundle with the NSX/20—a wise decision. Whatever portable you get, if you use Windows, get the TrackMan Portable. It's wonderful. In fact, it's so good that I am strongly tempted to attach it to the keyboard of my regular machine and abandon regular mice altogether. This gadget just plain feels right. It's also rugged enough for portable use.

A very large Chaos Manor orchid and a User's Choice Award to Logitech for the Pointing Device of the Year. Try this one. I bet you'll love it. I did.

CD-ROM

There were about a zillion CD-ROMs this year, far more than any one human could keep track of. However, one stands out above the others: the Bureau of Electronic Publishing's Monarch Notes are likely to have a major impact on the country. Monarch Notes, like *Cliffs Notes*, are short booklets that summarize various great works of literature, point out the intellectual lessons, draw conclusions, and ask questions.

They are supposed to be used in conjunction with the works they discuss rather than as a substitute for reading them, but we all know how that goes. I suppose it was inevitable that CD-ROMs would not only make available the world's great literature, but also make it easier to avoid reading it and still get college credit. Putting every one of the Monarch Notes on one CD-ROM certainly hastened the process. Having said that, I sure wish I'd had this disc when I was an undergrad; and on reflection, I think every college literature teacher had better get one in self-defense.

In any event, the User's Choice Award for CD-ROM of the Year goes to Monarch Notes from the Bureau of Electronic Publishing.

Games

This is an unusual situation. I had already chosen Broderbund's Patton Strikes Back, a Battle of the Bulge game by Chris Crawford, the genius dean of war-game designers, as game of the month and a candidate for game of the year. Like all Crawford designs, it's unique. The bias is toward playability and just having fun, and it does that. It also presents live-action video in small pop-up screens. There are sounds, advice from generals, and just all kinds of interesting features.

Then, just before Christmas, came another box: MicroProse's Civilization, the newest game by Railroad Tycoon designer Sid Meier.

"Too late to be considered," I thought, as I opened it. "But it doesn't hurt to have a look."

Six hours later it was dawn, and I was still playing. Look: do yourself a favor and do not buy this one just when you have an important deadline coming up. It's fascinating. Worse, it's addictive. Maybe more than addictive. In theory, it resembles the Avalon Hill board game of the same name; in some ways, it resembles Mark Baldwin's classic Empire; and overall, it's like nothing you've ever tried before.

Like Patton Strikes Back, you can play Civilization with very little attention to the manual; but like Railroad Tycoon, you will not play it well unless you study the manual very closely. This is a complicated game, and everything interacts with everything else. I like Crawford's game a lot, but Civilization stands out as the Chaos Manor Game of the Year and gets the User's Choice Award for that.

Winding Down

The CD-ROM of the month is Library of the Future, Series Second Edition, from World Library, Inc. (12914 Haster St., Garden Grove, CA 92640, (800) 443-0238). Nine hundred titles on one CD-ROM for $695.

There's more here, and I'm out of space. Next month, disk drives, both conventional and optical, CD-ROM drives, modems and communications, and backup systems. I'll be giving out more onions and orchids (including the Orchid and Onion of the Year) and more User's Choice Awards. I'll also have a look at multimedia and make some predictions about the Brave New Worlds the computer revolution is bringing us. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

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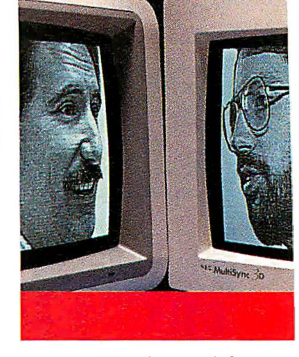


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ROUNDTABLE



BYTE editors debate the issues with contributors, readers, and industry experts

THE FUTURE OF PEN COMPUTING, PART 2

Roundtable is a forum in which BYTE editors, contributors, readers, and industry experts debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX, where you can participate in the round.table conference.

Last month, we talked about the markets for pen computers and the competing pen operating systems. Let's turn now to hardware issues. In many cases, pen computers have to be able to run for an entire workday without being recharged. What impact does that have on system design?

NEIL KATZ: Vertical users require that their batteries provide at least a full day's work. With current 386 designs and [the need to] minimize weight, this is virtually impossible. However, most vertical users do not run their machines continuously for 8 hours. They need a system with sophisticated power management. The system should sleep and draw minimal power when not in use.

Also, vertical users are more sensitive to battery life than laptop users are. When you're mobile, outside, and away from AC power, battery life becomes even more critical.

DAVID MENTLEY: It's amusing to see new microprocessor designs that save a few hundred milliwatts while the backlight for the display takes 3 to 4 watts. LCDs themselves burn up about half a watt. Nickel-cadmium batteries store about 40 watt-hours per kilogram or 18 Wh per pound. So a 1-pound battery at a 4-W consumption rate provides only 4½ hours of operation—when everything is working right. This analysis is just for a monochrome display. You can double the consumption, at least, for color.

These are not just temporary obstacles. Increasing the efficiency of backlights (both tube and film types) and batteries is more than a simple engineering task. Thousands of people have been working on it for decades. The question is whether or not you need a backlight. The clipboards clearly do not need it. Everything else does.

In bright, ambient lighting, [nonbacklit monochrome LCDs] reflect more light and look better. Backlit units look nice in a dark room and get progressively worse as the ambient lighting increases. A compromise is needed for covering both indoor and outdoor applications.

In the near term, a lot of these systems are going to be plugged into a vehicle's cigarette lighter socket if they are to be used all day.

Handwriting recognition is very slow on today's pen computers. Can we expect dramatic improvements in the near future?

JEFF DAO: The perception that handwriting recognition is too slow happens when people wait for the recognition response after writing each character. Those who write continually and naturally usually have the impression that current technology is fast enough.

DAN BRICKLIN: Current handwriting recognition is fine for many uses. For naming files, index topics, or objects, it often beats going from a mouse to a keyboard. When choosing from a constrained list (numbers only or city names, for example), many pen systems are quite good.

NICHOLAS BARAN: The single-tasking pen operating systems will not be able to offer the necessary performance for responsive handwriting recognition. But for basic forms entry, Communication Intelligence Corp.'s (CIC's) PenDOS, a pen-aware driver on top of MS-DOS, may be all that's necessary, let alone Windows for Pens or PenPoint.

STEVE LIFFICK: Unfortunately, handwriting recognition will never meet the expectations of the public at large. I tell folks who are disappointed that they should go back and try to read something they wrote a few weeks ago. How many letters can they make out? Is it reasonable

NICHOLAS BARAN
Co-editor,
Pen-Based Computing: The Journal of Stylus Systems

DAN BRICKLIN
Vice President,
Boston Development Center
Slate Corp.

JEFF DAO
Director of Applications Engineering, Communication Intelligence Corp.

NEIL KATZ
Tablet Systems Planning Manager
IBM Corp.

STEVE LIFFICK
Program Manager,
Windows for Pens
Microsoft Corp.

DAVID MENTLEY
Director of Display Industry Research
Stanford Resources

[to expect] a machine to read their writing better than they do?

There seems to be a consensus that handwriting recognition is slow. That hasn't been our experience with Windows for Pens. It recognizes *behind* the writer as text is being entered, so the delay upon finishing should never be very long—in essence, just enough to make segmentation (letter break) determinations and shape matching for the last two characters. This results in nearly immediate response.

We developed our recognition algorithms from the beginning to support cursive recognition. The problem boils down to insufficient CPU horsepower. The segmentation problem becomes worse by an order of magnitude because of ligatures. Combine this with the fact that people tend to write cursive more sloppily than block text, and one ends up with a requirement for lots of prototypes and lots of computation to perform recognition.

The situation with block versus cursive text recognition is analogous to interrupted versus continuous speech recognition. Continuous speech recognition is possible. It just takes a lot of CPU power.

DAO: Current handwriting-recognition technology uses a variety of methods: AI, neural networks, and fuzzy logic. Whatever one chooses to call it, handwriting-recognition software attempts to emulate what humans do very well at a very young age. We are exceptional recognizers, or image processors. We do a lot of pre- and postprocessing that these glorified calculators have not even begun to tackle. Yet the technology is useful in its current form with mixed upper- and lowercase printing. CIC's recognition system keeps up with a writer writing 30-plus words per minute. This is more than adequate.

As for cursive recognition, we're talking about a lot more million instructions per second [MIPS]. CIC already has a CR system running in the lab; however, today's 386 CPUs are not adequate for CR. Expect hardware capable of running a commercial CR product from CIC in a year's time.

What improvements will pen-computer designers make to achieve adequate performance, weight, display quality, and battery life at a reasonable price?

MENTLEY: I wouldn't look for full-color video-capable flat-panel displays on pen computers in the near future. Color-active matrix LCDs must have a backlight that requires 8 to 15 W of power. Other light-emitting flat panels are not yet available in full color, but when they are, they will be in the same power-consumption range as backlit LCDs. Another problem is the thickness. Placing the backlight behind the display makes the module nearly an inch thick. Light pipes and edge-mounted lights help, as Sharp has demonstrated with an edgelit active-matrix LCD for notebook computers. Digitizers also absorb light, increasing the backlight requirement.

Faster supertwist monochrome displays are clearly the trend. Supertwist technology is inherently slow, but producers (all in Japan) are desperately trying to get the speed up to video rates. The response time is temperature sensitive, however, and this is where pen computers may get into trouble. LCD response times get down to 1 second or so at winter temperatures. This leads to serious cursor "submarining."

On the other end, many of these pen computers are going to be sitting on car seats in direct sun in the summer. LCDs don't like high temperatures. The vertical-market environments are going to be much tougher on these systems than the broad-based horizontal applications in which we find laptops.

BARAN: There are several possibilities for storing data—PC cards with capacities of up to 16 MB are already available, and 40-MB cards are expected in the next couple of years.

Certainly, wireless networks will play a role, and PenPoint supports the AppleTalk network protocol. But again, PC cards will be the primary storage medium.

The PCMCIA memory-card specification is becoming the standard storage medium on pen-based systems (Momenta notwithstanding). And undoubtedly, there will be database applications designed to operate with these memory cards. However, this is all under development—not available right now.

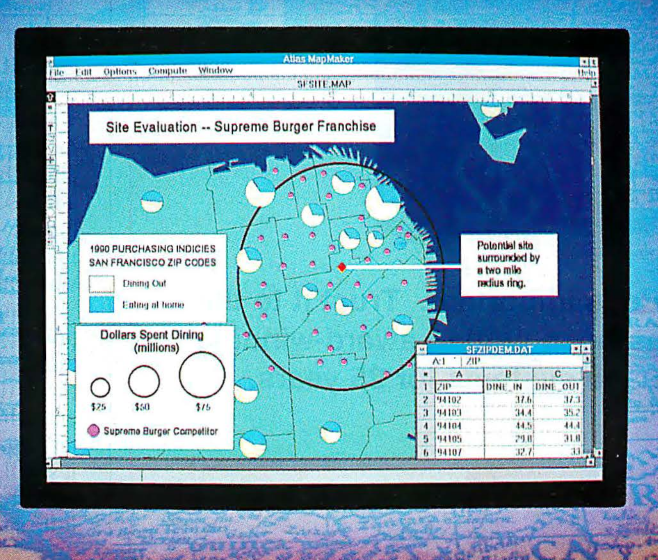
Might stylus-based systems be integrated with voice-based systems in the future?

LIFFICK: The integration of voice and pen control is inevitable. The strengths of the pen complement perfectly the weaknesses of voice input. Voice is inherently undirected. The pen is inherently very directed. Combine [voice recognition] with scenarios where the pen is appropriate, and the future of the pen is ensured.

The major factor delaying voice input in the marketplace is CPU speed. The 386 cuts it for nonconstrained (i.e., no required grammar) interrupted small-vocabulary input. High-end 486s bump up the vocabulary considerably for interrupted input and enable continuous input for a very small vocabulary. But if one considers

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handwriting recognition a hungry user of processing power, voice recognition is ravenous.

How would you sum up the current state of pen computing?

BRICKLIN: We have to realize that pen computers are a different beast. You don't want a traditional GUI on many of these machines (other than the Windows machine that happens to have a pen instead of a mouse), but rather a *PUI* (for pen user interface). Go Corp. has developed one such interface, which it calls *NUI* (for notebook user interface), but there will be others.

As the handwriting-recognition people point out, we need more MIPS. We need them for better recognition. We also need them to make the screen respond fast enough to feel "as good as paper, and better" (Slate's motto). When you turn a page, it should turn instantly. "Ink" should look as sharp as it does on paper but take up as little storage space as possible.

LIFFICK: Pen computing has become the favorite child of PC industry hypesters—with good reason. The prospects for pen input are particularly compelling: portability, natural pen and paper input, and bringing the benefits of powerful and easy-to-use computing to large, untapped markets.

The economic reality of pen computing is that inexpensive machines appropriate for the masses are two years out. There will always be "heat seekers" adopting the technology before it is economically reasonable to do so. But the large market for pen computing in the next two years will be with those entities that can justify its price in terms of real and immediate cost benefits. Those entities are corporations seeking increased productivity and prospective notebook buyers looking to extend the reach and scope of their current computing power.

KATZ: We're on the verge of a new era in computing, possibly as great or greater an opportunity than the original IBM PC. The opportunity is to bring the power of the computer to workers who cannot or will not use a keyboard in their day-to-day jobs.

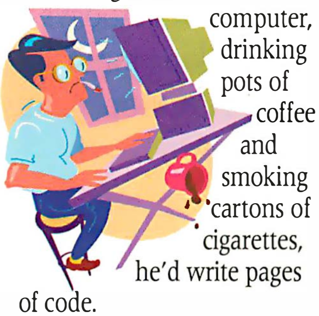
[It will take] hardware that is competitively priced, rugged, easy to use, and lightweight. More important, [it will take] an operating system and set of applications that are intuitive and friendly and present a noncomputerlike interface. All aspects of input will need to be brought to bear to make this market happen, including handwriting, voice, and wireless communications. The synergy of these will make this new market take off. ■

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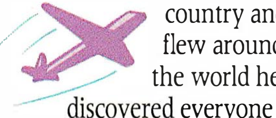
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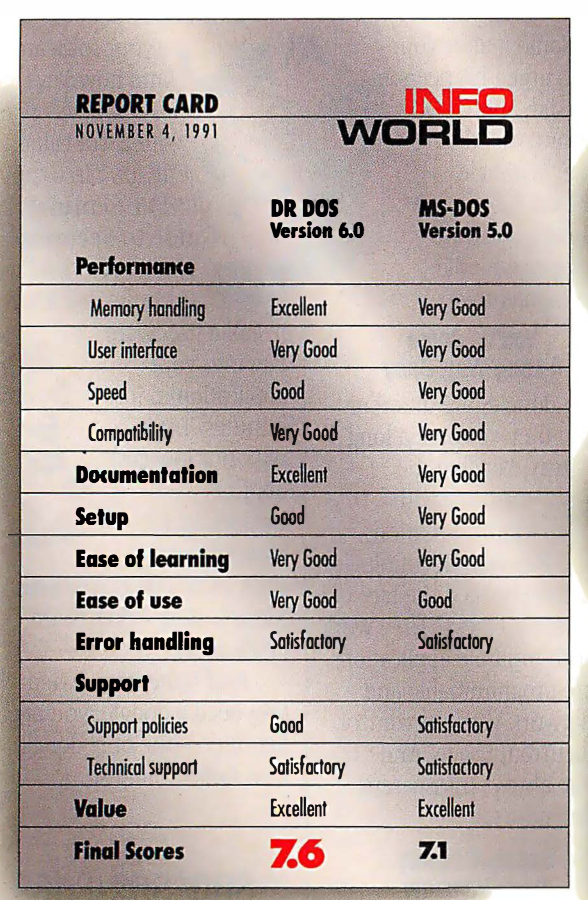
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COVER STORY

FEATURE

Practical Desktop Video

PART 1 - The BYTE Multimedia Lab introduces desktop video production in this first article in a series on desktop video

TOM YAGER

Few things in today's world are growing faster than our dependence on video-based information. The video medium incorporates the elements of color, movement, and sound in a way that we're powerfully drawn to. As a result, video can persuade and motivate more effectively than any other medium. It's no wonder that advertisers spend billions of dollars each year producing ads and placing them on TV: If you've got a point to make, you presently have no more efficient path into other people's minds than through video.

Today the power of video communication can be applied in a way you might not have considered: as a vehicle for *your* message. Desktop video production means that you, with the help of a computer, can express your ideas through sights and sounds that can make a powerful impression on your audience.

This article, produced by the BYTE Multimedia Lab, is the first in a series on desktop video. The focus of the series will be on practical uses for existing video technology. At the end, you'll know enough about desktop video production to get started creating your own professional-looking videos.

What Good Is It?

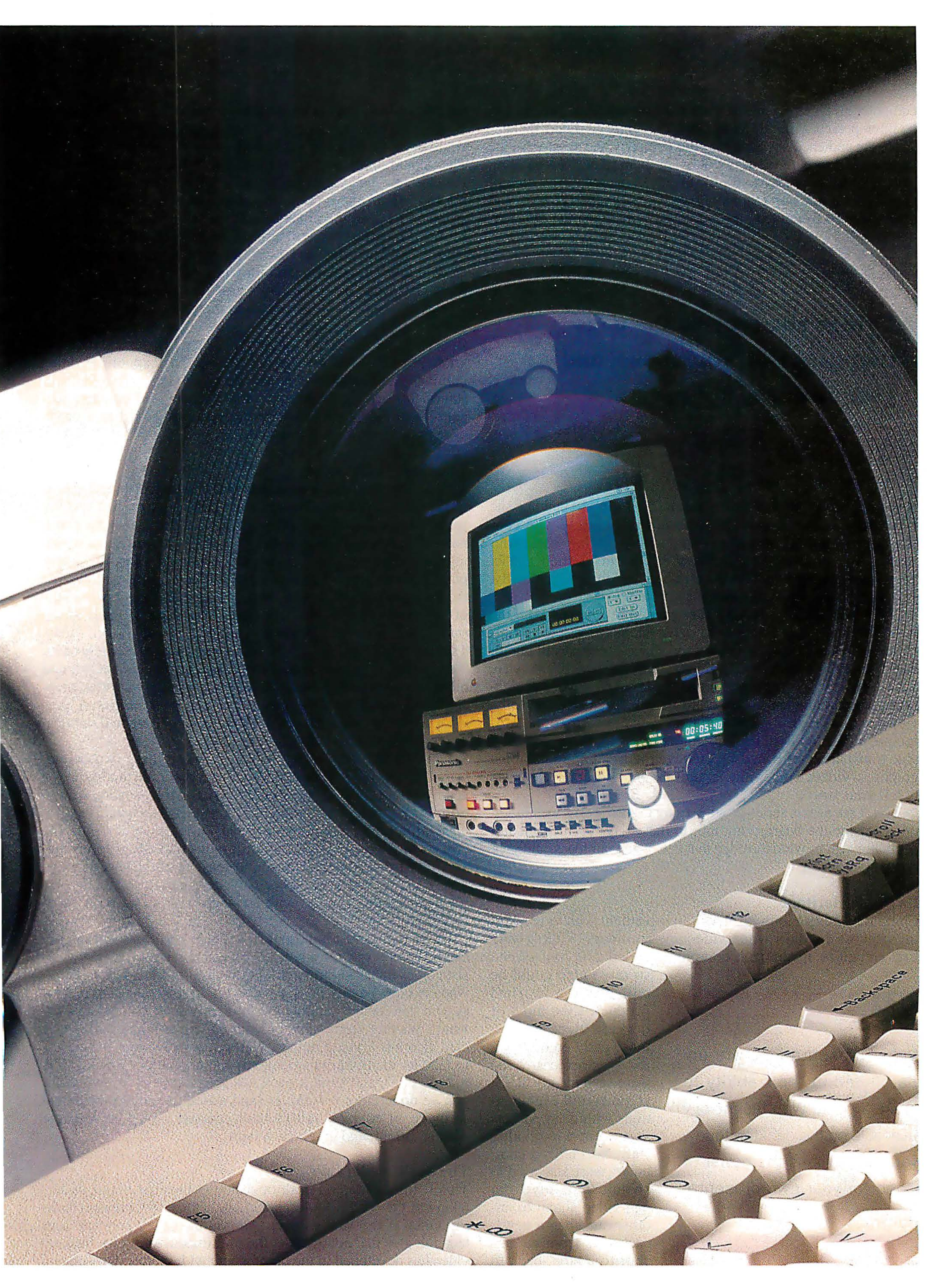
Even if you're willing to take for granted that you *can* produce your own videos, you might wonder why you'd ever want to. Consider this example: You run a construction company, and you're bidding on a contract for a huge office building. The client firm is looking for skill, experience, and an uncompromising dedication to quality. How do you convince the client's representatives, in the short time you have their attention, that your firm has these qualities and deserves to be placed above the competition? Today you'd probably pitch to them using time-honored methods: overhead transparencies, flip charts and magic markers, and perhaps even 35mm slides. The overheads might summarize your company's financial history, the flip charts might show rough plans for the project under consideration, and the slides might depict similar buildings already constructed by your firm.

The problem with these presentation methods is that they do nothing more than put dry facts in front of your audience: Everything else is up to you. When you place your presentation on video, however, all you do is insert the cassette and press Play—the presentation speaks for itself. No facts are forgotten, no slides get inserted upside down, and no smudges or fingerprints obscure your message.

Beyond such mundane considerations, video lets you present facts and figures as



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computer graphics—using animation if you like. The graphics can be interspersed with live video, voice-overs, and music that advance the audience's respect for your company and ensure that the facts are interpreted the way you want them to be. The building plans can become a virtual prototype—a shaded, three-dimensional model that you can view from several angles, rotate, and even place in simulated surroundings. Video lets you transport your audience to other places. You can take them to a building site where your engineers can be seen working closely with construction crews, include them in a planning meeting where your staff is discussing a project similar to the one in question, and let them see the people behind the numbers and the plans. Finally, you can show them your completed projects.

Video can provide the edge that gets you, your ideas, and your company noticed.

The value that video adds can be seen in several ways. Of the traditional methods mentioned earlier, none offers the combination of sound, color, and motion. Video combines them all, and these things attract and hold an audience's attention. Also, a well-done video presentation always makes a more professional impression than a stack of transparencies or slides. Finally, video is unique in its ability to condense information. A 5-minute video can hold the equivalent information of innumerable transparencies because you have the freedom to combine graphics, video, voice, music, animation, and other elements to tell your story.

You'll see as this series progresses that video works well in settings outside the boardroom, too. In these days of intense competition, it can provide the edge that gets you, your ideas, and your company noticed.

BYTE ACTION SUMMARY

Video presentations are unparalleled in their ability to make a point. With technology available on the desktop today, you can harness the power of video for your own presentations.

Its Noble Heritage

Computers have a long history of involvement with video, dating back to the days when videotape recorders (VTRs) were first cabled to specialized computers called *edit controllers*, so raw video could be edited into a finished product. Like most of desktop video's roots, these early editing systems were expensive and were seen mostly at TV stations and organizations with deep pockets and a knowledgeable staff. Specialized computers were also used to switch smoothly from one video signal to another, as when a newscast goes from the anchor to a tape, back to the anchor, and then to the weather reporter.

More expensive versions of these systems (called *switchers*) could do more than just cut or fade between two video sources: They could apply special effects. The least of them did *wipes* (i.e., the new video replaces the old in a sweep across the screen), but the best of them could do advanced effects like mapping video sources to the sides of a cube and spinning it through space. Computers were also used to generate text (*character generators*) and graphics (*paint systems*). There are many other examples of computer technology in video, and the amount of digital hardware used in today's broadcast and professional facilities far outstrips what existed in the early days.

Even today, however, many of these capabilities—editing, switching, special effects, character generation, and graphics—are handled by several specialized systems capable of doing nothing else. The old-fashioned edit controllers still exist, as do stand-alone character generators and specialized graphics systems. To be fair, each has advantages (though sometimes small) over its desktop video equivalent.

The Quality Question

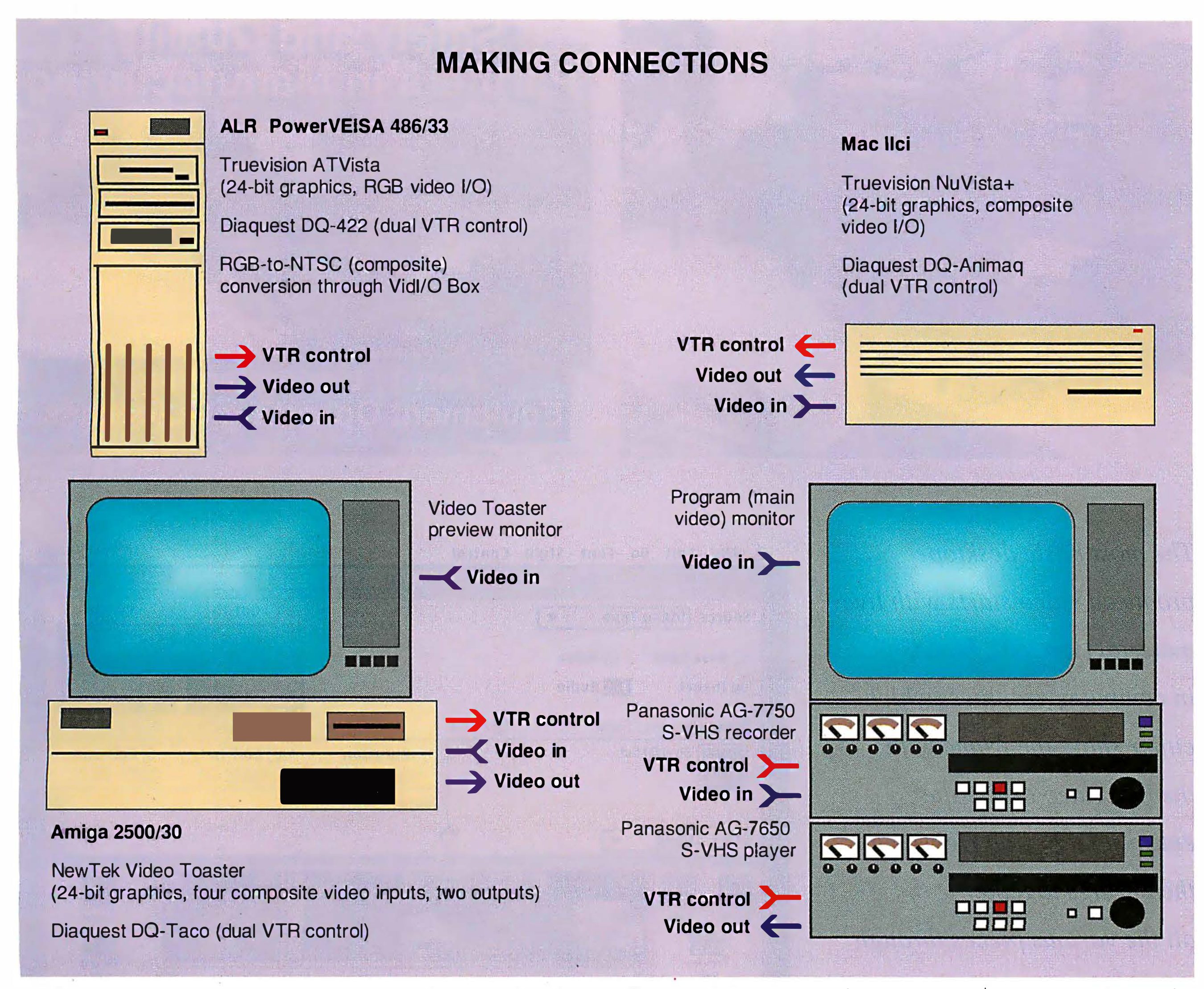
Among the advantages of expensive, component-based gear is quality: Everyone who spends large sums of money on specialized equipment expects *broadcast quality*. That's a phrase you'll hear often in association with video, and it has different meanings depending on who's saying it. For our purposes, I'll simply place broadcast quality as a far right tick on a quality scale. It's the best you can get, and to get it, you need to invest in the kind of gear you'd find at CNN or CBS. On the far left side of the scale, place a tick at consumer-quality, or hobby-level, video. This is where standard VHS VCRs and most camcorders fall. You can also find inexpensive titlers, editors, enhancers, and other modules at this level, but what works well for video snapshots falls apart on a 20-inch monitor in the boardroom. And what starts out bad only gets worse during editing and duplication processes.

Our domain will be somewhere between these two boundaries. Between consumer quality and broadcast quality lies a somewhat newly defined market area known by several names. Some call it *prosumer*, while others call it *industrial*, or *commercial*, quality. Whatever you call it, it's easy to spot. The video side is dominated by equipment that often looks and acts like broadcast gear but is at least slightly less capable. The VTRs and players themselves are tuned to producing stable, high-quality images with enhanced resolution (compared to VHS).

But perhaps most important, most video gear in this category can be computer controlled. That's where the real computer assist comes in. The computer takes control of the VCR, telling it when to play, record, pause, and so on. If you add a card to your system that handles an incoming video signal, you can display what's playing on the tape on your computer's monitor. If that card also has a video output, you immediately gain the ability to take an incoming video signal, add computer graphics to it (e.g., a title), and send it back out again to be recorded. Once you've done these few things (and added the not-so-incidental software, of course), you've built yourself a very inexpensive editing, titling, and graphics system.

The Multimedia Lab

This feature series on desktop video is the first major undertaking of the BYTE Multimedia Lab, and there's a reason desktop video is the first subject. Among the many concepts and technologies that come under the multimedia umbrella, desktop video has developed to the point where widespread adoption and



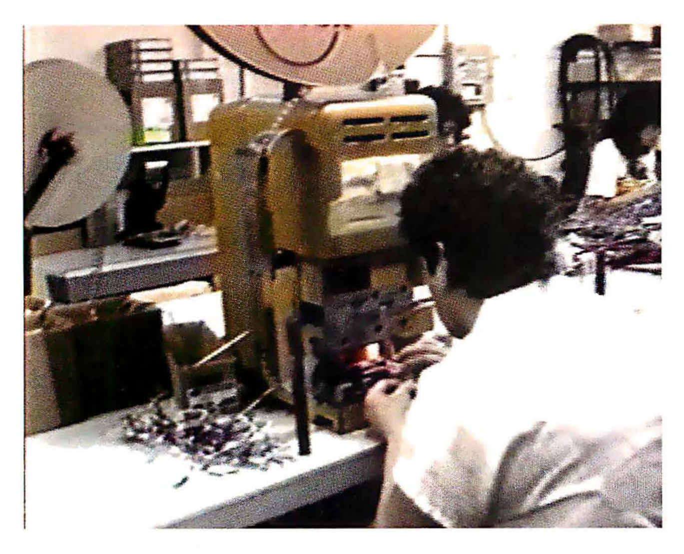
All three systems in the BYTE Multimedia Lab are equipped to handle video I/O. The end of the line is always the video input of the AG-7750 S-VHS VCR. If only the real interconnections were as neat and manageable as in this diagram.

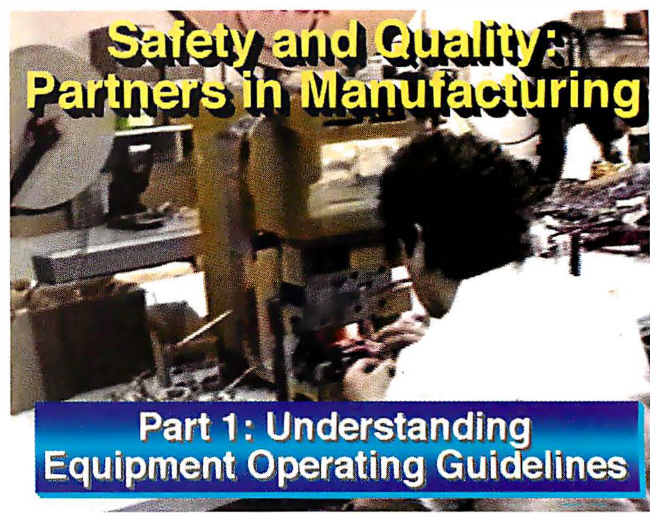
use is possible. While standards for other types of multimedia applications are just beginning to emerge, it's already possible to build effective desktop video setups around the platform (more or less) of your choice.

Like BYTE, the Multimedia Lab takes a multiplatform view of the world. I decided to employ three systems I believe represent the bulk of BYTE's readers. The PC system is an ALR PowerVEISA 486/33 with 13 MB of memory and a 600-MB hard drive. The Mac IIci has 8 MB of memory and an 80-MB hard drive. The Amiga 2500/30 has 7 MB of memory and a 370-MB hard drive (330 MB of which is on a Micropolis SCSI drive I installed). You'll notice that these are all pretty beefy configurations—everything you've heard about multimedia being demanding of memory and disk space is true.

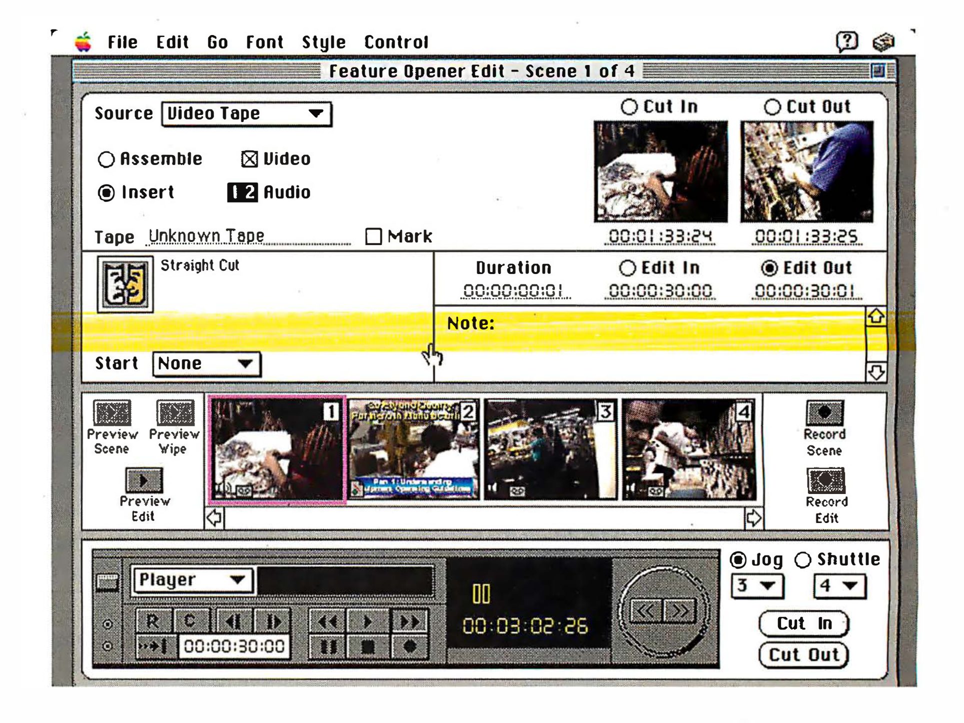
The video-related hardware came next. Since I'm not evaluating products per se, I chose not to duplicate equipment where it could be avoided. In this endeavor, three veterans of the video industry—Panasonic, Diaquest, and Truevision—made building the lab much easier. Panasonic provided most of the video equipment: a pair of computer-controllable Super VHS video decks (one AG-7750 recorder and one AG-7650 player), three (model BTM1310Y) professional monitors, and a Super VHS camcorder. Diaquest outfitted all three computer systems with the video-synchronized, intelligent serial interfaces needed to control the decks. They not only tell the decks what to do, but also collect input from the decks regarding tape position, status, and so on. The Diaquest DQ-422 board in the PC also acts as the main source of video synchronization for the entire lab. (Its importance will be made clear in the next article.) The Mac and the Amiga have DQ-Animaq and DQ-Taco boards, respectively.

Truevision provided the professional video cards for the PC and the Mac. The PC's ATVista card uses an external signal converter (called the VidI/O Box) to translate composite (or recordable) video signals to RGB for processing and then convert the board's RGB output to video for recording. The ATVista doesn't replace the PC's main display card, so it must be specifically supported by applications. Fortunately, the ATVista is popular enough that support is widespread. On the Mac, the NuVista+ handles video I/O directly (without the external converter). Both cards offer 24-bit (or true color) graphics, video overlay (i.e., computer graphics added to an incoming video signal), and limited special effects. The Amiga's video I/O and





The most basic desktop-produced video starts with live material (top left), blends in computer graphics (which either share the frame with the live video or use the entire screen) (top right), and then brings together all the various pieces through editing (bottom right).



nearly everything else is handled by a NewTek Video Toaster. The Toaster has most of the same capabilities the Truevision boards have, but the Toaster has custom chips on-board that perform dazzling digital special effects and other functions.

The figure shows the lab's video setup more clearly. There's more to the picture than this, and I will go into more detail in future articles. I plan to introduce you to the various products in the lab as they come into use.

Making the First Connection

Video I/O boards (actually a misnomer, because these boards do much more than just process video) like the Truevision NuVista+ and ATVista let you mix computer graphics and incoming video in just about any way you can imagine. These boards, however, do not drive the main display of your computer system—that is, the display on which program interfaces appear. That's because a recordable video signal, thanks to its use of interlacing and its reduced resolution, makes a poor carrier for complex user interfaces.

The Mac in the Multimedia Lab uses an 8•24 GC card to drive its interface display, while the PC uses a standard VGA adapter. The Amiga uses three displays (the third is for the "preview" signal, described later). But when the Video Toaster is in use, all the displays flicker because the Amiga can synchronize its on-board video controller to an external signal (a process called *genlocking*), and the Video Toaster asks it to do that. As a result, the Amiga's interface display flickers when the Toaster is being used, but the Toaster software adapts its interface appropriately.

Using two (or three) monitors on your system may seem redundant and wasteful, but it has a distinct advantage: The separate interface display lets applications interact with you using

all the screen space they need, without worrying about getting out of the way when it's time to record. And since the second monitor is typically for the signal being sent to your recording VCR, you can use a single monitor to view both the live, recordable computer output and the playback of the videotaped result. Some applications, however, require the broader color range of the video I/O board for their interfaces.

While it's often worthwhile to create a computer graphic and record it to tape, it's much more valuable to combine computer-generated graphics with external video. Take, for example, the image in the screen on page 110. The background image of a person working on a piece of manufacturing machinery came from a videotape that was shot with a camcorder. I hooked the video output from the AG-7650 video player to the video input on the Mac's NuVista+ board. I then used a presentation graphics package to construct the text and graphics, leaving the background a solid color. Next, I used AT&T Graphics Software Labs' StudioMaster Pro software to turn the graphic into an overlay by selecting the graphic's background as the *key color*. StudioMaster Pro moved the playback tape into position, loaded the graphics file, and switched on the NuVista+'s video overlay. The key color becomes transparent, so the video on the NuVista+'s input appears wherever the key color (the background, in this case) is painted. The combined image—video input plus computer-generated graphics—appears on the NuVista+'s video output, suitable for recording to tape.

This entire exercise took about a minute to complete, and it wouldn't have been much more difficult on the PC or the Amiga. This bird's-eye view of a titling exercise is only for illustration, but it should start you thinking. Any system that does video overlay (including inexpensive systems like external Amiga genlocks and specialized VGA cards for PCs) is generally capable of combining computer graphics and video in whatever way you like, provided the video fills the entire screen. Nearly all video input cards also allow you to capture an incoming video signal, freeze it, and store the frozen image as a file for use elsewhere. The combination of moving video, captured images, and computer-generated graphics is a powerful one, as you'll see. But for now, I will digress and put a couple of thorny issues to rest.

The Great Format Wars

It would save a lot of time if you could take the video side of desktop video for granted, but you can't. The gear required to do the job properly can't be found in a department store or even in most video specialty stores. The equipment I selected for the lab, based on criteria I think most desktop video producers would use, falls into the industrial and "prosumer" classes I described earlier. What sets these units apart from consumer equipment are cost, quality, and computer controllability.

There are a number of standards for methods of recording video on tape. These are referred to as *video formats*, and there are more of them than you can imagine. But if you limit your scope to the formats that are affordable to people less well-off than Ted Turner, some cost/capability isobars begin to emerge.

Closest to the average desktop video producer's comfort zone lie two relatively new video formats: Super VHS (S-VHS) and high-band 8 mm (Hi8). As their names suggest, both are improvements

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over the existing VHS and 8-mm formats. At a minimum, these improvements increase the resolution of the basic formats, but most S-VHS and Hi8 decks also employ other image-quality enhancements.

Even though these two standards deliver roughly the same image quality and call for similar levels of investment, they are at odds with each other. Just as in the VHS-versus-Beta wars of old, proponents of S-VHS and Hi8 are battling for the same audience. In my view, it shouldn't be so; the Multimedia Lab incorporates both formats into its work, and I couldn't imagine it any other way. Hi8 is attractive because of its mix of high quality and light weight. My Canon A1 Digital camcorder weighs less than 4 pounds—battery, tape, and all—and it's considered a heavyweight among midrange Hi8 camcorders. It travels well, and despite its birdlike physical attributes, it doesn't skimp on features or quality.

Hi8 suffers, however, from the very things that make it so appealing. Because the tape is so compact, the video heads have less surface area on which to "spread out" their signal. Dropouts (i.e., image degradation caused by flaking of the tape's magnetic coating) are common after several plays and tend to be much more noticeable than on larger formats. Some Hi8 tapes are less susceptible to dropouts than others, but in general, Hi8 is not durable enough for the thrashing that tapes get in a typical editing session. For gathering material, however, Hi8 is perfect.

An S-VHS tape weighs a ton by comparison. S-VHS tapes and gear are not nearly as easy to carry and use as Hi8. But S-VHS has proven, in my experience, to be equal to the demanding requirements of editing and multiple plays. A number of highly capable professional S-VHS video decks have been released recently, and these units are, in all ways except cost and image quality, the equal of broadcast decks costing much more. It's a fringe benefit that these decks are also capable of recording and playing standard VHS tapes; there's no need for a specialized VHS mastering deck.

The equipment mix I finally settled on for the Multimedia Lab takes advantage of the best attributes of both formats. All the live video is collected using Hi8 camcorders and then is transferred to S-VHS for editing. Animations and other strictly computer-generated material are sent directly to the AG-7750, which has frame-accurate computer control and other attributes that I will describe later.

Segue Alert

Now that you understand some of the basics, it's time to take a breather until the next article in this series. There, you'll begin doing some *real* work, pulling together the raw materials that are part of a typical desktop video production.

You'll learn more about live video acquisition, film transfers, video capture, and image enhancement. I'll discuss the products and techniques used to acquire and shape these materials, which can later be combined to form finished productions. ■

Tom Yager is the director of the BYTE Multimedia Lab. You can reach him on BIX as "tyager" or on Internet as tyager@bytepb.byte.com.

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(408) 996-1010
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AT&T Graphics Software Labs
(Video processing software)
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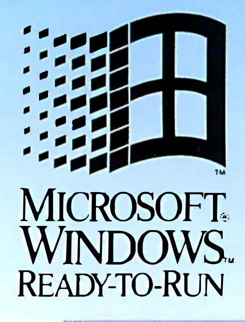


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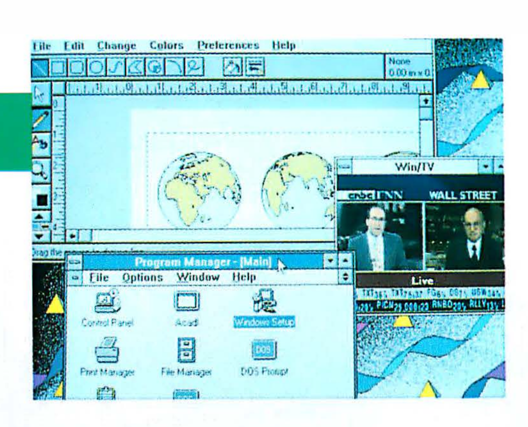
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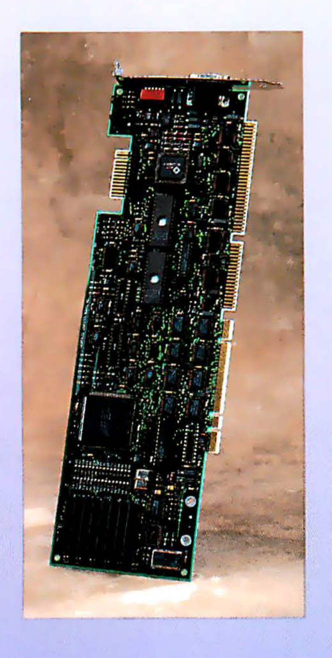
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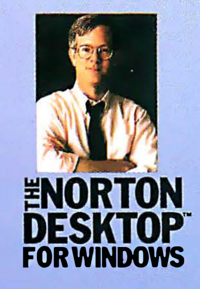
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Windows Goes Real Time

The iRMX for Windows operating system provides the best of both worlds: real-time and DOS/Windows applications together on a single PC

KRISHNAN RAJAMANI, NARJALA BHASKER, RICK GERBER, AND STEVE SNYDER

Real-time applications have long been the domain of expensive proprietary hardware. But the relatively low cost of personal computers, the range of GUIs they can support, and the variety of software packages available for them make small systems an attractive alternative. The question is, can real time on personal computers work with acceptable response times and without losing access to popular DOS and Windows applications?

DOS certainly does not provide the bed for the multitasking necessary for real-time applications; nor does it provide adequate run-time support for them. TSR programs provide only a semblance of multitasking. Even Windows doesn't provide the preemptive priority-based multitasking that sophisticated real-time applications need.

Equally important, neither DOS nor Windows guarantees a bounded interrupt-response time (i.e., the time that elapses from when an interrupt occurs to when its interrupt handler starts to execute). Historically, proprietary kernels (i.e., operating systems) have provided the bounded interrupt latency, deterministic task-switch time, and other features that real-time applications need.

However, completely abandoning DOS and Windows in favor of a proprietary real-time kernel is not attractive, either. Such a solution forsakes the wealth of GUI, data-analysis, and display packages that are available under DOS and Windows. Without these packages, it's hard for real-time applications to meet the expectations of personal computer users. "Reinventing the wheel" on proprietary kernels also is not cost-effective.

Systems designed to support real-time applications must respond to external asynchronous events within a predictable time frame. Whereas *real time* is often interpreted to mean *fast*, a better synonym would be *predictable* or *deterministic*. The technology inherent in making a system real-time can add significant benefits to any application that requires a predictable response time. Real-time systems must support asynchronous I/O to maximize predictability. This support goes further than just making I/O fast; it enables a system to concurrently execute other portions of an application during I/O.

Intel's iRMX for Windows operating system forms a bridge between DOS/Windows and real time. (Note: We use the term DOS/Windows here to imply either DOS alone or DOS and Windows together.) This operating system runs DOS/Windows as a single task under the iRMX (for real-time multitasking executive) 32-bit protected-mode operating system. It allows you to use the capabilities of iRMX with the Windows GUI to develop real-time applications supporting a wide

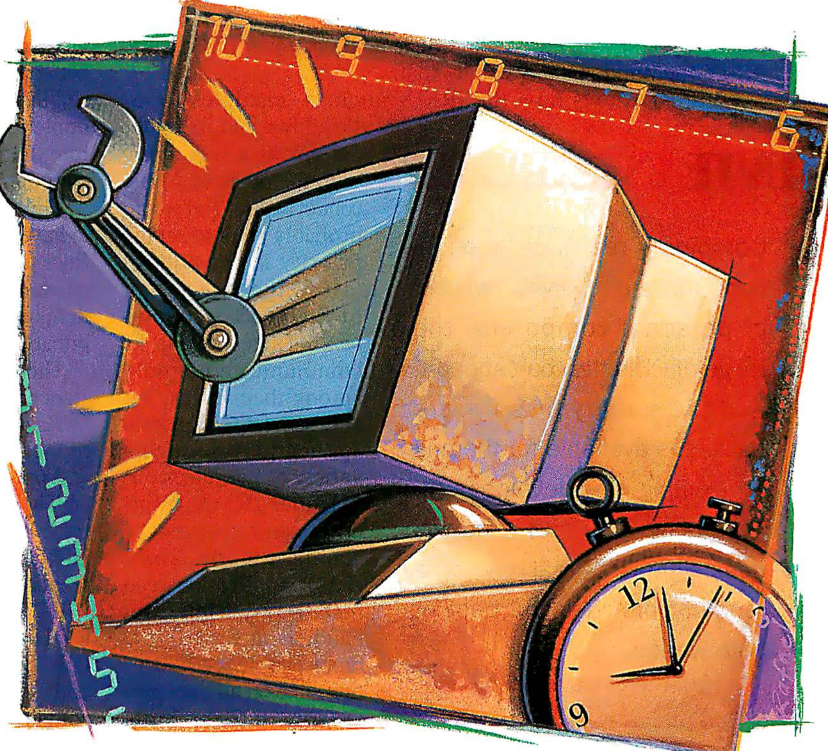


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range of configurations, from single CPU systems to multiprocessor systems based on networks or Multibus II. (For more information on iRMX for Windows, call (800) 438-4769.)

In the past, the iRMX family of operating systems was focused on either component-level applications or applications using Multibus. (For more information on the characteristics of the iRMX operating system, see the text box "Exploring the iRMX Pedigree" on page 122.) With the advent of iRMX for Windows, iRMX has been unbundled from such proprietary hardware. iRMX for Windows will run on any IBM- or Compaq-compatible 386 or 486 machine.

The extended features of the 386 architecture, such as V86 mode, multiring protection, and multiple address spaces, make the marriage between DOS/Windows and iRMX possible. (Note that the term iRMX by itself refers to the non-DOS/Windows aspect of iRMX for Windows.)

A Real-Time Windows Application

Picture a hypothetical control system, say a luggage-tag engraver, running on a personal computer. The luggage tags sit in three bins, each bin containing different colored tags. For each engraving request, a tag is retrieved from the appropriate bin and placed on a conveyer. The conveyer moves the tag to an engraving station where a robotic arm moves it to an engraver. A vacuum pump activates to hold the tag in place and clean the station of engraving debris. The engraver activates and engraves the tag. When the engraving is complete, the robotic arm places the tag back on the conveyer, which moves it to a collection point.

The upper section of figure 1 shows the real-time components of such an application. Typically, they consist of control tasks of varying priorities and, perhaps, some hardware interrupt handlers. Together, these tasks and interrupt handlers control and respond to hardware events in a timely manner.

Imagine that a Windows screen (e.g., an Excel window performing order entry for the system, a custom window displaying a graphical representation of the control system replete with moving parts, a soft-control panel, and so forth, illustrated at the bottom of figure 1) conceals the control system illustrated at the top of the figure. Now picture a PC simultaneously running the control system with the user interface at the bottom of the figure. iRMX for Windows lets you do that.

Figure 1 shows how the iRMX nucleus schedules DOS/Windows and its applications as a task along with the other real-time control tasks. (You would probably want to set the priority of the control tasks higher than that of the DOS/Windows task.) The control tasks communicate not only among themselves, but also with DOS/Windows applications through a variety of interfaces.

Under iRMX, Windows can run in real or standard mode. Since iRMX applications can install 32-bit interrupt handlers at Ring 0 (the most privileged execution state on an Intel processor, and the state where operating-system kernels normally run), they get control directly, regardless of the processor mode, with a bounded latency.

BYTE ACTION SUMMARY

Combining real-time applications with the relatively low cost of personal computers, the range of GUIs they can support, and the variety of software packages available for them is an exciting new development. Accessing DOS and Windows capabilities in a real-time environment provides the best of both worlds.

A Multitude of APIs

Since iRMX for Windows merges different operating systems, it contains a rich set of application programming interfaces. An application may not need all of them, but their availability provides flexibility. The APIs fall into three categories: native iRMX APIs for iRMX tasks, native DOS and Windows APIs for DOS/Windows programs, and Bridge APIs that allow DOS/Windows programs to communicate and synchronize with iRMX tasks.

The iRMX APIs include system calls that support preemptive priority-based multitasking, interrupt management, exception handling, 32-bit memory management, and intertask communication, synchronization, and mutual exclusion. These APIs also provide device-independent I/O and network access.

DOS and Windows provide the native DOS and Windows APIs. Since DOS and Windows actually coexist with iRMX, the full range of native DOS APIs is available. Windows is optional, and its associated APIs are available if you load it.

The typical application envisioned for iRMX for Windows includes the interaction of real-time components; of user-interface and non-real-time components; and of real-time components and non-real-time components, including the user interface. With these functions in mind, you would use iRMX APIs to implement the real-time components of the application; DOS/Windows APIs to run the user-interface and non-real-time applications, such as a spreadsheet; and the Bridge APIs to bridge between the real-time components and the user-interface components.

Bridge APIs

The Bridge APIs come in three forms: real-time extensions, network interfaces, and Dynamic Data Exchange. The RTEs provide a critical subset of iRMX services—including semaphores and mailboxes—to DOS/Windows programs. A DOS/Windows program can use these primitives just as any other iRMX task would. The standard networking interface lets DOS/Windows programs use the NetBIOS interface to talk to iRMX tasks. Windows provides the DDE mechanism for programmatic communications between applications. Many popular applications, including Excel, Intouch, Visual Basic, and Toolbook, support DDE largely to implement the notion of links between documents. DDE is therefore the key to providing iRMX applications with the ability to communicate with standard Windows applications.

The DDE communications model considers each application to have a set of data items named by strings. Each application defines the format and meaning of data-item names (e.g., Excel requires that data items referring to cells use RnCn notation). Data items are located using an address with three elements: the application name, the topic name, and the data-item name.

The topic name distinguishes among multiple application instances. For example, with two instances of Excel active, the DDE mechanism uses the name of the file that each instance is running to distinguish between them.

Applications can set and query data items owned by each other. They can also ask to be notified if a data item's value changes for event-driven operation. An application that actively makes DDE requests is called a *DDE client*. An application that passively responds to them is called a *DDE server*.

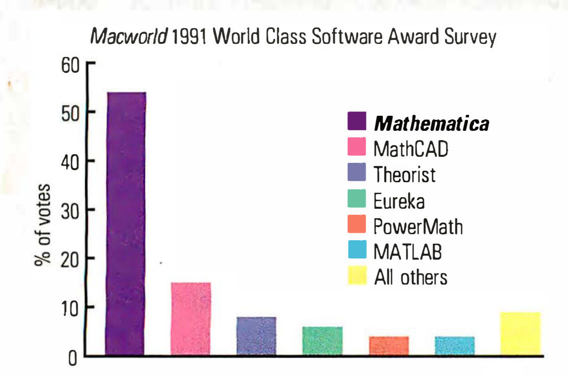
DDE support in iRMX for Windows consists of two elements: a DDE Library to enable iRMX applications to participate in DDE communications, and a DDE Router Windows program that converts them to network communications. The DDE Library contains simple calls that iRMX DDE clients use to set and reset

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Exploring the iRMX Pedigree

The iRMX family of real-time operating systems has been on the market for more than 13 years. It is widely used in such mission-critical applications as check and mail sorting using high-speed imaging, medical instrumentation, machine and process control, satellite communications, energy management, financial trader workstations, and Automatic Teller Machines.

The basis of the new iRMX for Windows operating system is iRMX III. The new system is a true 32-bit multitasking operating system with real-time programming facilities, including the following:

- Preemptive, priority-based task scheduling with optional round-robin (or time-slice) scheduling within a priority level.
- Advanced interrupt-management facilities that provide a deterministic response to asynchronous external events.
- Efficient memory management with 4 gigabytes of memory accessibility.
- Multiple intertask communication and mutual-exclusion mechanisms to provide optimum task cooperation.
- Full integration with the protection mechanisms of the 386 architecture for clean-code enforcement and program isolation.
- An extensible set of system objects with built-in type checking for increased programming clarity.

The iRMX model for program isolation is an object called a *job*. A job defines the environment for a program and contains all the resources that its various components use. Each job has its own memory segments. Its resources are by default private but can be made public, if desired, so other jobs can use them.

A job can have multiple threads of execution, each of which is called a *task*. Tasks are the active objects within a job. Each task has its priority specified when it is created.

Tasks progress through a number of action states while they exist, between running (in control of the CPU), ready (preempted by a higher-priority task), and delayed (waiting for an event). Tasks communicate with each other through system calls, which include the following:

- `send_message` lets a task send system objects, such as segments, to object mailboxes.
- `receive_message` lets a task receive system objects, such as segments, at object mailboxes.
- `send_data` lets a task send data to data mailboxes.
- `receive_data` lets a task receive data at data mailboxes.
- `send_units` lets a task send several abstract counting units to a semaphore.
- `receive_units` lets a task receive several abstract counting units from a semaphore.
- `catalog_object` allows a task to catalog the name of a mailbox or semaphore in a job's object directory so that other tasks can look it up by name and use it for intertask communications.
- `lookup_object` lets a task look up the name of a mailbox or semaphore in a job's object directory and use these exchanges for intertask communications.
- `signal_interrupt` lets an interrupt handler signal an interrupt task to provide additional processing for an interrupt—processing that the interrupt handler itself cannot provide.
- `wait_interrupt` lets an interrupt task wait for an interrupt that needs special processing.

Task priorities and these intertask communications mechanisms provide all the tools necessary to meet the real-time requirements of even the most demanding applications. Other calls allow the creation and deletion of these various exchanges, as well as the removal of objects from object directories. The various receive calls have time limits associated with them, so tasks that use them may be blocked (or delayed) until the requested information is received.

Other system calls also exist and provide management for memory, objects, exception handlers, interrupts, files (including device-independent I/O), and operator interfaces. The iRMX III operating system also allows you to define new object types and produce new system calls to manipulate objects of these new types. Such extensibility provides a great deal of flexibility.

---

data items in DDE servers. It also provides calls that iRMX DDE servers use to advertise data-item or topic names and register handlers to invoke when requests arrive for any data item.

The DDE Library communicates with the DDE Router using a simple applications protocol built with standard network interfaces. This protocol extends DDE addressing by adding the network name of the machine. So a DDE address has four components: a machine name, an application name, a topic name, and a data-item name. Both polled and event-driven operations are possible for iRMX applications.

Of the Bridge APIs, RTE is more efficient than the network interface or DDE, but it is not natural for DOS/Windows programmers. NetBIOS and DDE are more familiar. In fact, many Windows software packages already support data manipulation via DDE. So, it may be more convenient for iRMX tasks to communicate with those packages in that way.

Using NetBIOS or DDE to communicate between DOS and iRMX has another subtle advantage. NetBIOS and DDE lend themselves to transparently distributing the real-time and user-interface components across multiple machines. The user interface and non-real-time components could execute on one machine while the real-time elements execute on another. Communications between the components could then occur over the network.

However, you don't need network hardware if the entire application resides on a single PC. The networking interfaces work transparently whether short-circuited on one machine or dispersed across several systems. Similarly, the network-based DDE Router provides transparent scalability for the DDE interface.

continued

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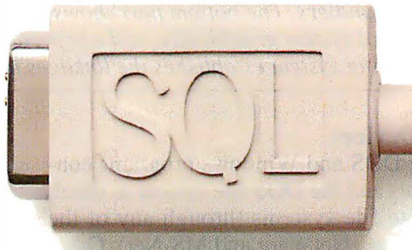
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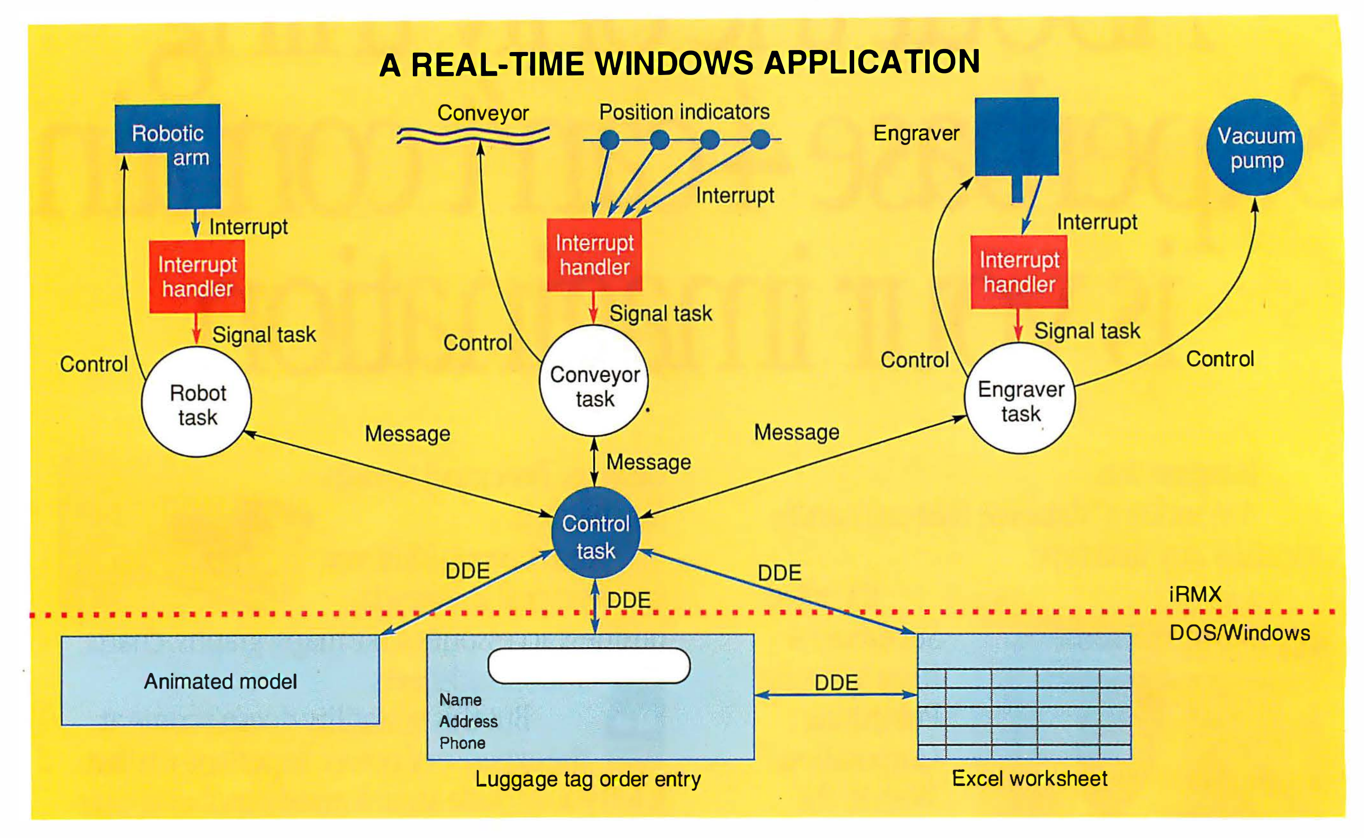


Figure 1: *The top part of the figure details the real-time components of a luggage-tag engraving application, including control tasks and hardware interrupt handlers. The bottom part shows a Windows screen (e.g., an Excel window for order entry, a custom window showing the control system graphically, and a soft-control panel), which might conceal the control system at the top. The iRMX for Windows operating system establishes the linkages to accomplish this on a PC.*

File Systems and Other Devices

Under iRMX for Windows, DOS and Windows programs continue to access I/O peripherals and the DOS file system as usual. They can also access remote file systems through any of the available network products (e.g., NetWare and MS-Net). Other iRMX tasks can access these file systems simultaneously via native iRMX I/O APIs. Here, iRMX requests are internally translated into DOS service requests.

Optionally, iRMX also provides a native iRMX file system that can reside on a separate disk, co-reside with the DOS file system on a partitioned volume, or exist elsewhere on the network. However, iRMX tasks use the same iRMX APIs to access either the DOS or the iRMX file system.

DOS programs can also map drive letters to iRMX file systems and access the iRMX files via the usual DOS I/O APIs. In this case, requests are internally translated into iRMX service requests.

A special iRMX for Windows API allows iRMX tasks to invoke real-mode software interrupts. Thus, the tasks can directly access special DOS device drivers as well as standard DOS or ROM BIOS services.

Remote file sharing includes both client and server capabilities. Since the DOS file system is visible to iRMX, a system running iRMX for Windows can enable remote clients to access the DOS file system while simultaneously allowing DOS/Windows and iRMX tasks to access remote servers. And since remote file systems are also visible to iRMX, that same system can act as a gateway for clients that can't access them directly. For example, an MS-Net client could access a Novell server in this environment.

iRMX for Windows also provides ISO transport services to iRMX tasks via Intel's PCL2A Ethernet controller. A network redirector subsystem allows NetBIOS applications from DOS/Windows to share that controller. DOS/Windows programs can also access a wide variety of other network hardware and software.

Under iRMX, applications can dynamically install new device drivers at run time. These drivers have a well-defined interface to the iRMX I/O system. Applications access them via device-independent APIs and through special driver-specific APIs.

The device drivers in iRMX for Windows run at Ring 0. The associated interrupt handlers obtain control directly, regardless of processor mode. This not only improves interrupt latency for device drivers, but also removes the burden of installing dual-mode interrupt handlers. Under iRMX for Windows, applications can also install operating-system extensions to define new APIs and even new object types at run time.

The Inside Story

To establish DOS as an iRMX task, you first boot DOS and load a special iRMX TSR, which reserves a small portion of conventional memory for iRMX. Next, the iRMX for Windows loader puts iRMX in extended memory, where it takes control of the CPU in protected mode and initializes each of the operating system's internal layers and system tasks.

This initialization creates a special system task and dispatches it in V86 mode to the loader's return address. Then the loader cleans itself up and returns to COMMAND.COM, which resumes the DOS idle loop. DOS is now set up as an iRMX task, and all subsequent DOS programs will execute in this context

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Close-Up Dual Pack 4.0	672	★★★★	★★★★	★★★★	★★★★	★★	★★★	★★★½	★★★★
CO/Session 6.0	674	☆☆☆½	☆☆½	☆½	☆☆	☆☆☆½	☆½	☆☆☆½	★★½
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Remote2 2.1	676	☆☆☆	☆☆☆☆	☆☆½	☆☆½	☆☆☆½	☆☆½	☆☆☆½	★★★
Takeover Lite 2.0	677	☆½	☆½	☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆½	★★

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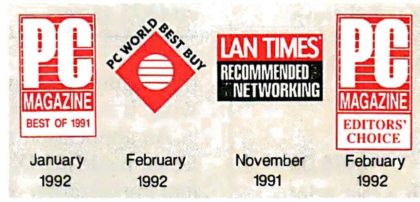
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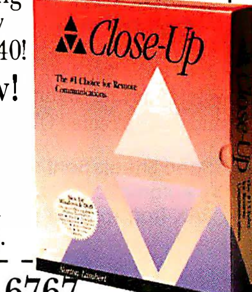
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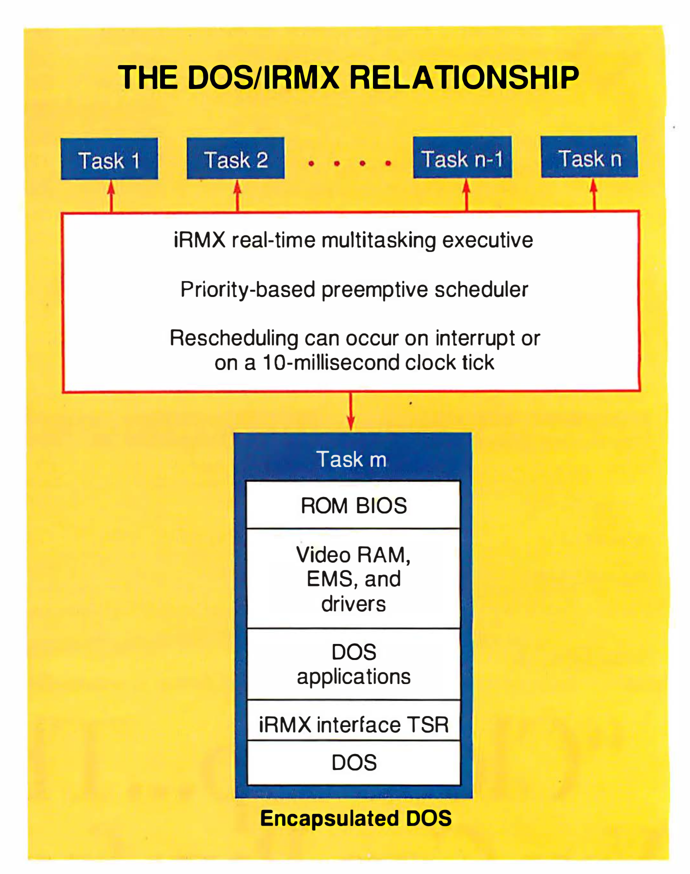


Figure 2: *DOS runs as an iRMX task like any other in V86 mode. The DOS task contains a normal DOS system complete with drivers, ROM BIOS, and applications. In that same iRMX task, you can initiate Windows just as you would on a dedicated DOS system.*

(see figure 2). Now you can start Windows from DOS, if you wish. It will run in the same iRMX task that DOS does.

An application's real-time components can be loaded as protected-mode iRMX jobs at any time, either automatically after system initialization or manually from the console. Several jobs can run in the background, and each can contain multiple tasks.

The iRMX kernel runs in protected mode at Ring 0, while DOS and real-mode Windows run in V86 mode. If you load Windows in standard mode, it runs in protected mode but at a less-privileged level than iRMX. iRMX owns the global descriptor table and interrupt descriptor table, as well as its own local descriptor table. Standard-mode Windows has a private LDT.

Initially, iRMX owns and manages all the extended memory. Standard-mode Windows obtains extended memory from an iRMX Extended Memory Specification driver. Windows is then responsible for managing its own extended memory. The XMS driver provides functionality similar to that of HIMEM.SYS. Figure 3 shows how DOS, Windows, and iRMX use system memory.

The iRMX kernel schedules native iRMX tasks along with the DOS/Windows task according to priority. iRMX switches the CPU between V86 mode and protected mode as required when switching between tasks or dispatching interrupt handlers.

Any task, including the DOS/Windows task, can take hardware interrupts. The system first traps those that DOS/Windows handles in Ring 0 and then reflects them to the appropriate real-mode handler or Windows protected-mode handler (see figure

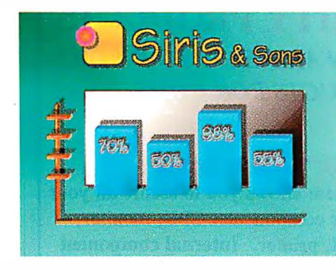
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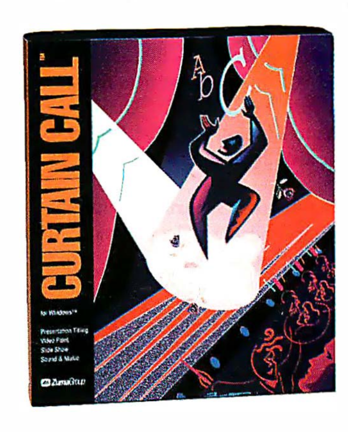
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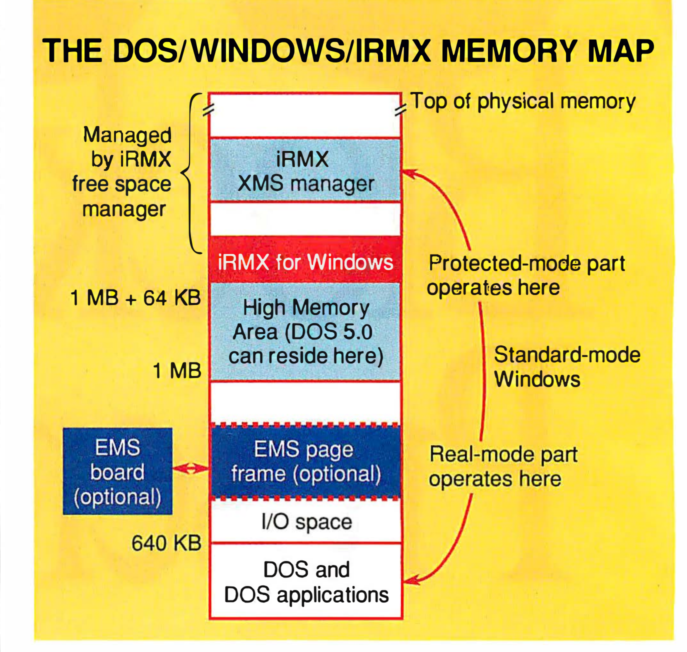


Figure 3: *How do DOS, Windows, and iRMX share system memory? At first, iRMX has all the extended memory. Then, standard-mode Windows obtains some from an iRMX XMS driver, which functions as a high-memory manager, taking responsibility for its management.*

4). It also traps the return from these handlers to ensure that the interrupted task resumes execution in the appropriate CPU mode.

Similarly, the system traps all software interrupts from DOS/Windows programs and reflects them to the appropriate DOS/Windows handler. It also traps any attempt by Windows to switch the CPU between real and protected mode. iRMX for Windows performs any mode switching.

In addition to CPU sharing, iRMX shares other hardware resources with DOS and Windows. DOS and Windows can use the numerics coprocessor for floating-point instructions, as can iRMX applications, since iRMX maintains the numerics register context on a per-task basis. Both iRMX and DOS/Windows need the timer, so iRMX traps timer interrupts and reflects them to DOS or Windows at appropriate intervals. Also, iRMX and DOS/Windows can share hard and floppy drives. iRMX uses DOS APIs to access these resources. The iRMX TSR serves as a surrogate DOS process in whose context iRMX can obtain these services.

Remaining Predictable

Despite the presence of DOS/Windows and their applications, iRMX for Windows guarantees real-time response for critical iRMX tasks. First, the priority of a DOS/Windows task is low; it will run only when higher-priority tasks are idle. Higher-priority real-time tasks can preempt DOS/Windows tasks at any time.

Second, by using 386 protection features, iRMX traps any attempt to disable CPU interrupts from DOS or Windows. The actual CPU interrupt flag is always set to enable interrupts whenever DOS/Windows is running. However, iRMX maintains the DOS virtual state of this flag so that it won't reflect any hardware interrupts while DOS/Windows has disabled CPU interrupts. This ensures the integrity of DOS/Windows while it bounds the latency for iRMX hardware interrupts.

Third, iRMX traps DOS/Windows' I/O instructions that modify the interrupt masks of the programmable interrupt controller. The

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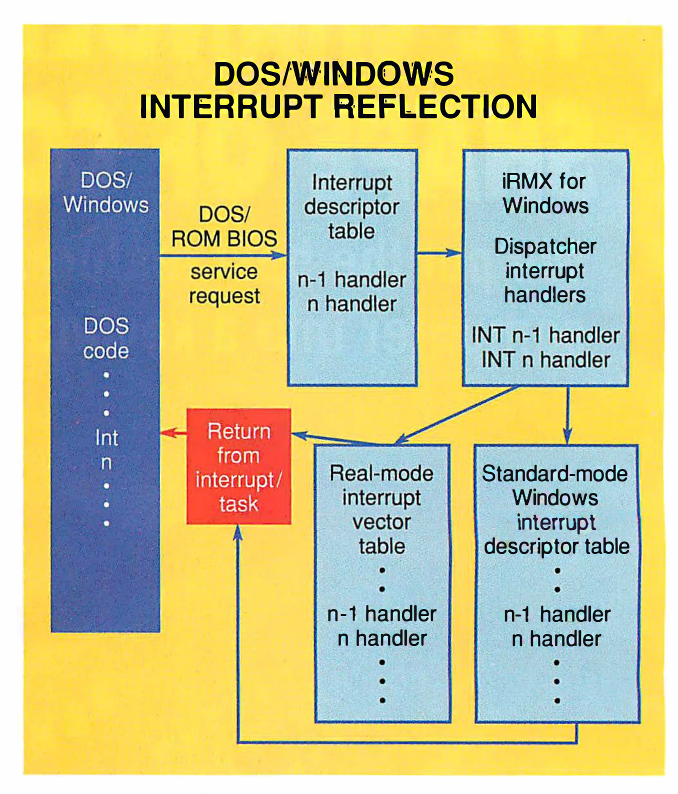


Figure 4: *Any iRMX task, including DOS/Windows, can initiate hardware interrupts. The system traps DOS/Windows interrupts in Ring 0; reflects them to the appropriate handler, whether real-mode or protected-mode; and then traps the return to route the tasks to the appropriate mode.*

operating system emulates PIC operations in such a way that DOS cannot change the mask for iRMX's interrupt levels. Each interrupt controller has two logical parts: iRMX owns one, and DOS/Windows owns the other.

Finally, iRMX ensures that tasks above a certain priority do not take DOS/Windows interrupts. Thus, an application task can guard itself from long interruptions, such as a long list of TSRs triggered by the timer.

Making Trades

Trade-offs occur in uniting iRMX and DOS/Windows. To preserve the determinism of iRMX-owned interrupts and high-priority tasks, DOS and Windows pay a performance penalty.

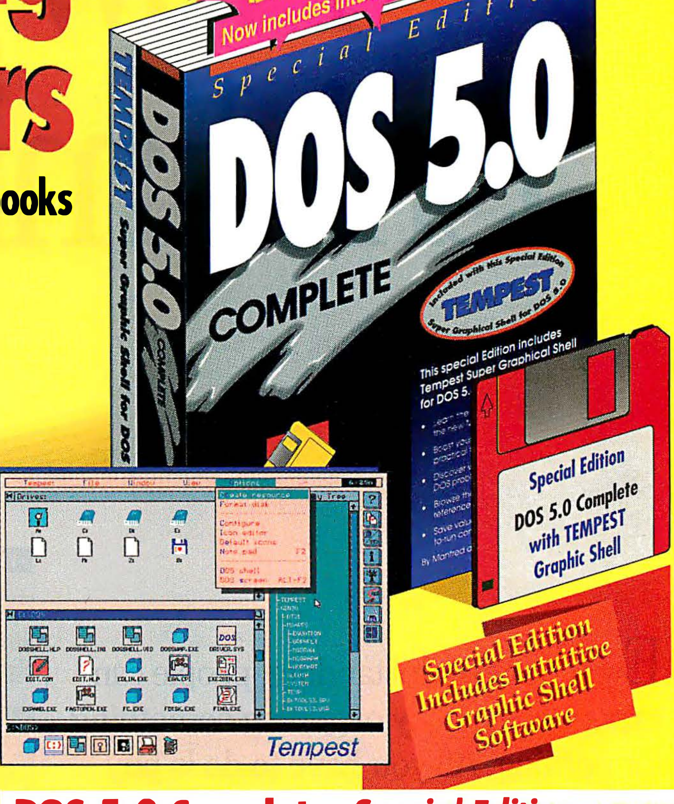
Similarly, to maximize the device independence of standard AT peripherals, iRMX does not access them directly, but uses DOS and the BIOS to do so. iRMX for Windows doesn't require special device drivers to access a drive or file system. An alternative would have been to emulate DOS file and other I/O services with higher-performance device drivers and file systems.

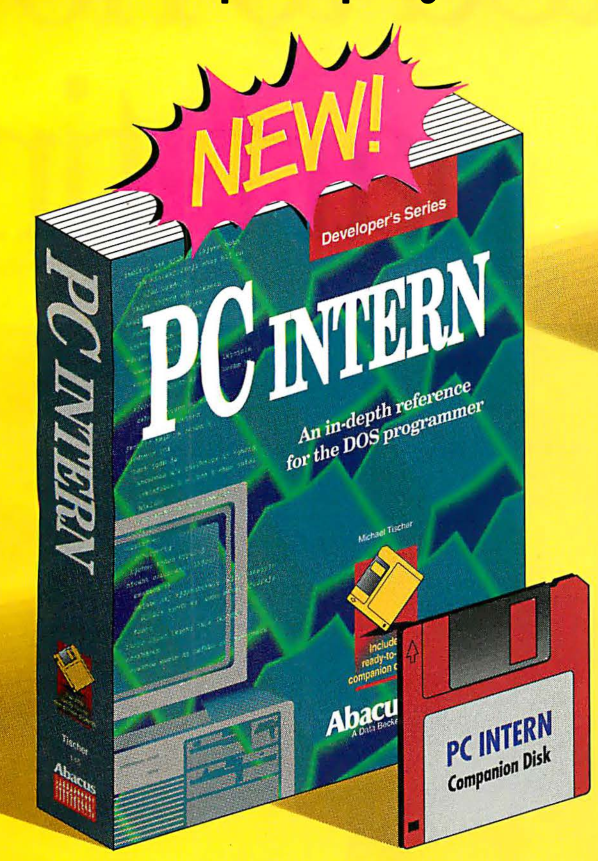
This marriage sacrifices the functionality of enhanced-mode Windows (e.g., virtual memory and multiple DOS sessions). But it supports the faster standard-mode Windows. Despite these trade-offs, however, iRMX for Windows brings real-time applications to the PC. More than that, it encourages their cohabitation with DOS/Windows applications, providing the best of both worlds. ■

Krishnan Rajamani, Narjala Bhasker, Rick Gerber, and Steve Snyder are senior software engineers at Intel Corp. in Santa Clara, California. You can reach them on BIX c/o "editors."

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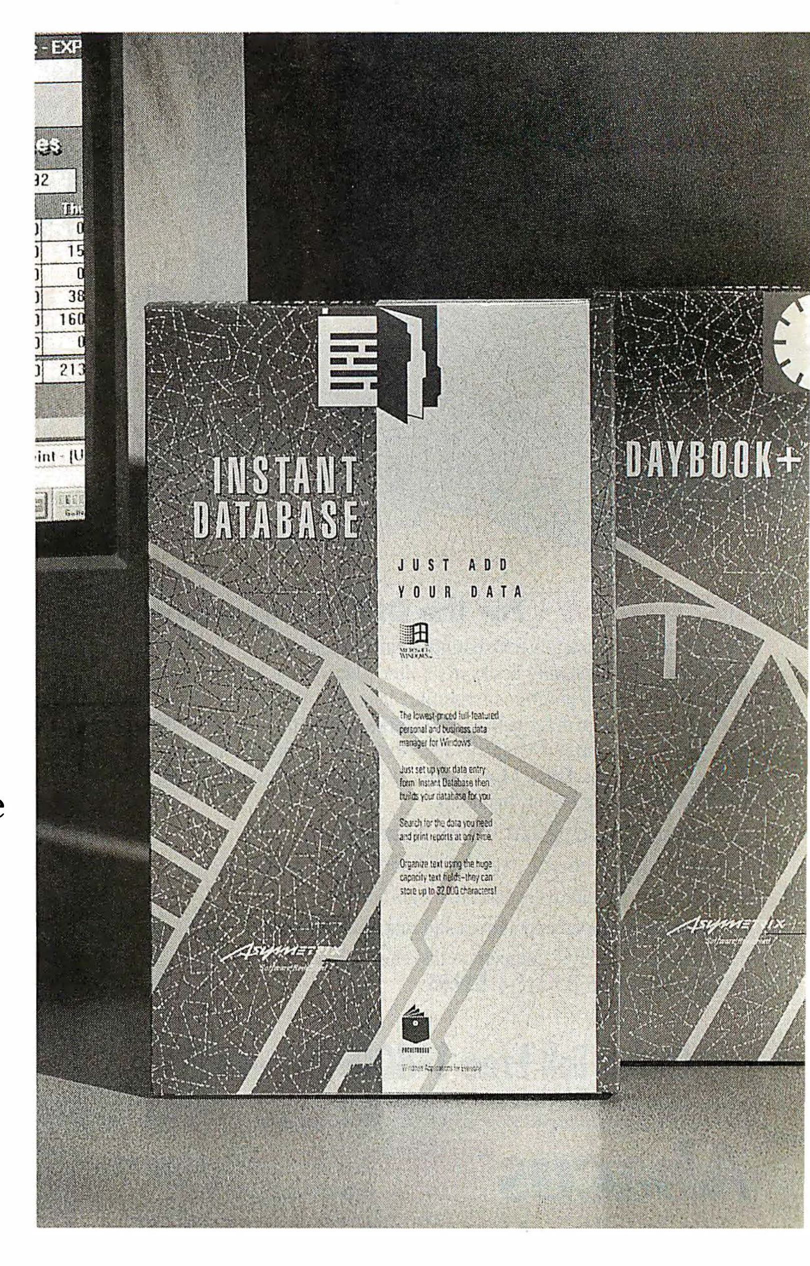
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KINDER, GENTLER COMPUTING

Natural I/O technologies make your computer work for you, instead of the other way around

MAUREEN CAUDILL

It's April 1993, and you've just purchased a top-of-the-line personal computer from Big Apple. You open the box and begin to assemble it, but to your surprise, you don't see a keyboard, only a special pad and pen that resemble those in an executive portfolio. The box also contains clothing: a body suit, a pair of gloves, and a headband. You see no monitor, only a helmet and goggles. What's going on here?

What you're about to experience is your first taste of natural computing: making computers interact with users in a humanlike manner. Natural computing emphasizes how computers interface with humans on a sensory level rather than through the cognitive command logic today's devices use.

Natural computing intrinsically deals with human sensory perception. Neural networks, or processing systems modeled after the human brain, are particularly good at the low-level sensory tasks that digital computers find difficult to perform.

Natural input includes such technologies as speech and handwriting recognition and gesture interpretation. Natural output includes speech; meaningful, humanlike gestures and motions; and virtual-reality environments.

Natural I/O is the ultimate user-friendly interface. It places the burden of communication squarely on the computer rather than on the human: Instead of the user having to learn the computer's preferred interface, the computer must deal with the user's preferences. Although computers have been moving in the direction of natural I/O for years, the relevant enabling technologies are only now becoming mature enough to make this capability a reality in the immediate future.

Learning to Talk

Probably the first thing you thought of when you read the term *natural I/O* was a speech interface, so it's no surprise when you discover that your Big Apple system comes complete with a microphone and stereo sound. (Speech I/O is new; sound in general is not. Since 1990, systems such as the Next machine and the Macs have included sound capabilities as a part of their standard configurations.)

With natural-speech input, you face the two separate but interdependent problems of speech-to-text conversion and natural-language processing (NLP). Natural-speech output technologies confront the problems involved in speech generation.

Some excellent systems use hybrid expert-network technology married with traditional digital signal processing (DSP) techniques. Because words and phonemes frequently require several fractions of a second to utter, the sonograms (visual patterns representing sound waves) for even discontinuous words represent very large, complex blocks of data. Also, because of variations in pitch, tone, accent, dialect, and pronunciation, computers have an extremely difficult time recognizing even simple words like *cat*. They can do it, however, under limited circumstances.

Any number of commercial products offer single-speaker, single-word voice-recognition capabilities with various levels of competence. A few can handle single-speaker continuous speech with a small vocabulary, and some can process multiple-speaker discontinuous speech with limited vocabularies. But very few can handle many speakers, continuous speech, and large vocabularies.

"Speak," Typewriter

In the late 1980s, Teuvo Kohonen of the Helsinki University of Technology developed a



voice typewriter using a combination of all available technologies: DSP, rule-based systems, and neural networks. It's this blend of the traditional and the new that made it such a success.

Using the voice typewriter, you speak into a noise-canceling microphone. The sounds you make are digitized into a 12-bit Gray Code and are sampled every 10 milliseconds, and a Fourier transform (a mathematical technique that converts time-sampled data to the frequency domain) is applied. The transform, of course, discards phase information in the signal—a weakness in this preliminary design.

The frequency-smoothed logarithms of the transformed signals are reduced in dimension to normalized 15-element vectors. A series of vector-quantizing neural networks categorize these vectors into probable phoneme-text conversions. The main neural network handles simple conversions; specialized networks process more subtle distinctions (e.g., between the sounds of \k\, \p\, and \t\) separately. A rule-based expert system then corrects mistakes and handles contextual or coarticulation problems (a coarticulation effect is one where the pronunciation of a phoneme is affected by the previous or the following phonemes; see figure 1).

The voice typewriter has achieved some remarkable results. It was tested using the most extreme speech-to-text case: multiple speakers, continuous speech, and a large vocabulary. Although the first 100 or so words from each speaker were used as training data for the neural network, the system did not have to be trained on the complete vocabulary of each speaker—only on a representative sample of words.

Under these conditions, the voice typewriter achieved between 92 percent and 97 percent accuracy in converting speech to text. Further, it was able to type the text on a system monitor with a time delay of only about a quarter of a second.

These results are not quite good enough

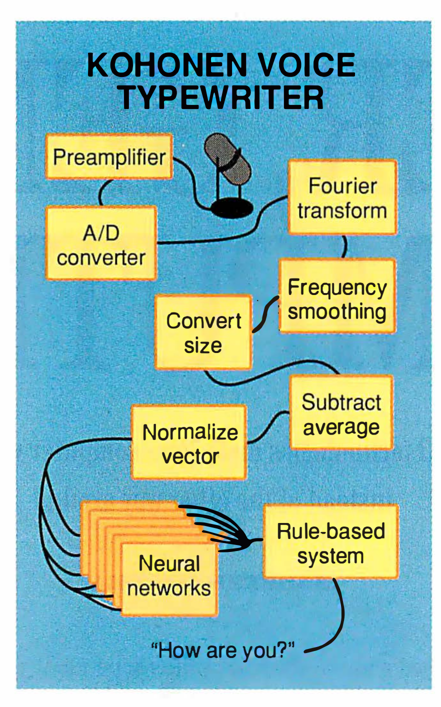


Figure 1: *The Kohonen voice typewriter marries conventional digital signal processing with neural networks and rule-based experts to produce an excellent speech-to-text system that responds in about ¼ second with accuracy in the 92 percent to 97 percent range.*

for widespread commercial use; the voice typewriter is a little too slow and inaccurate for the average user to accept. Nevertheless, this marriage of multiple technologies into a finely crafted solution provides strong clues to how future speech solutions may be constructed.

Say What You Mean

Although great strides have been made in speech-to-text conversions, the ability to convert sounds to characters doesn't mean you can construct a system that comprehends words. Solving this essential piece of the puzzle falls into the realm of NLP.

NLP is probably the most difficult challenge that AI researchers face. If they can build devices that truly understand human language—natural language—they will have a powerful tool that will open the way for breakthroughs in other areas.

NLP involves a series of issues that begins with straightforward syntactical analysis of a sentence parsing and continues with semantic analysis, in which the structures identified in parsing are interpreted as pertaining to objects in the known environment. Once these steps are complete, each sentence has to be correlated with the entire conversational history.

The challenges of producing NLP systems are enormous, and research is going on in many areas. The greatest successes have been in the realm of syntactical and semantic processing in highly restricted knowledge domains (see the text box "Giving Feeling to Speech" on page 168).

Scripts and Frames

Two basic components of NLP, context correlation and pragmatic interpretation, are far less developed than semantic and syntactic parsing. Each of these basic components requires access to one or more databases that contain extensive knowledge about the world; thus, knowledge representation becomes a critical issue.

One classic technique for storing such knowledge is a *script*, which is an environment in which actors and objects have stereotypical roles that are correlated with objects in a sentence. Semantic parsing associates words with these stereotypical notions and can use the known roles in the stereotype to reveal the meaning of the sentence.

A restaurant script, for instance, might contain roles for the waiter and the diner, as well as the associated actions (e.g., reading a menu, ordering a meal, or serving a meal) of the appropriate actors. People mentioned in a sentence who look at or receive a menu might be assigned the role of diners. The comprehension/reason for their visit to the restaurant (i.e., hunger) would be coupled with the probable aftermath of having eaten food (a satisfied appetite and a smaller amount of money).

Another common way of representing knowledge is by using a frame system. In this scenario, each object has associated inheritable properties and attributes. These individual frames are linked as nodes in a directed graph structure (i.e., a semantic network) that illustrates the relationships between the frames. Usually systems identified as *frame-based* have more organization than those labeled *semantic networks*, but the general characteristics of both are the same.

AI researchers have recently realized that cooperating processors can achieve more, faster, than any one processor. As a result, many more NLP systems are being implemented using parallel architectures—preferably on parallel hardware (e.g., hypercubes or transputers). However, using multitasking operating systems provides limited parallel performance.

Interprocess communication is handled most frequently by the *blackboard* method, a technique that allows independent processing modules to post information in a common area (i.e., a blackboard) for other modules to access. Alternatively, message-passing systems can direct information to

BYTE ACTION SUMMARY

Finally, there are easier ways to interact with your computer. With the coming of natural I/O technologies—innovative GUIs, better speech I/O, and novel interfaces—your computer will do more of the work for you.

Music: A Natural Link to Our Emotional Selves

TOD MACHOVER

Many of us believe that the most significant element missing from computers is emotion. One of the ways people convey information is through emotional content. Because music is an important way people communicate emotions, why not use it to interface with our computers?

New Ways to Use an Old Friend

People often think of music as a pleasant enhancement to their everyday lives. They listen to music on the radio while driving a car, on a Walkman while exercising, as a soundtrack of a motion picture, and as soothing ambience while dining or reading.

Various domains of research are transforming the way people learn, perform, listen to, and understand music—the way they naturally integrate it into their lives. These changes suggest that music may soon assume a more central role in our lives.

Researchers are developing a new generation of musical instruments intended to combine virtuosic performance and intelligent computer monitoring. For instance, the MIT Media Lab's hyperinstrument project, which I've directed since 1986, has developed techniques that allow musicians to use their skills on a traditional acoustic instrument to control many simultaneous layers of computer sound. Recently, researchers at the media lab developed a hypercello for the artist Yo-Yo Ma.

A hyperinstrument is a computer simulation of a musical instrument that goes beyond the capability of the real instrument it's based on. Hyperinstruments are intended to greatly expand a human's control of the instrument and the sound it produces. Few other human skills involve such direct and natural translation of mental concepts into physical movement. Hyperinstruments provide examples of the future of human-computer interface devices.

In their design of hyperinstruments, researchers are trying to develop a purely musical interface: to have the control information transmitted from the user to the computer (and vice versa) either through the natural gestures of the musical performance or through the music itself. This model is important because music seems to represent an abstract outline of people's psychological states.

Although most hyperinstruments are designed for skillful musicians, examples of similar technology are surfacing in applications for music students and music lovers. Researchers are developing systems that will allow people to learn to play instruments, to conduct a virtual orchestra at home, or to learn about musical structure through interactive video games.

The Role of Technology

Ideas such as these bring up important philosophical questions: Should technology encourage creativity or simulate it? Should human-computer interfaces enable everyone to perform certain difficult tasks equally well (serving a kind of prosthetic or compensatory function), or should they allow individual differences to produce different results?

My own work has led me to believe that technology should always promote individualism. Natural applications of technology should permit people to use their skills to control and shape uncharted expressive regions. Certainly, new possibilities discovered through increasingly natural uses of technology should stimulate individuals to master new skills. Musical models truly can help people create new and increasingly natural tools—that is, if they listen carefully.

Tod Machover is an associate professor of music and media at the MIT Media Lab (Cambridge, MA) and director of the lab's experimental media facility. He is a pioneer in the development of hyperinstruments, and his recordings have won many awards both in the U.S. and internationally. You can reach him on BIX c/o "editors" or on Internet as tod@media-lab.mit.edu.

specific modules for action. The blackboard approach was used by L. Erman in the Hearsay II and Hearsay III speech-recognition systems.

In Hearsay II, each independent processing module contains semantic or syntactic information about the language. The blackboard posts hypotheses about the meaning of a particular sentence organized along two axes: time and processing level. A control system supervises the modules to improve the likelihood of success.

On activation (as determined by the control system), each module examines the state of the blackboard and either modifies the existing hypothesis or writes a new one. When it completes its task, another module performs the same procedure. Specific situational triggers determine when each module should be activated.

Some of the latest NLP systems use neural-network or fuzzy-logic technologies to enhance these AI approaches. In particular, researchers are considering the use of neural networks to implement semantic networks and frames (as well as other directed acyclical graph applications). Fuzzy logic is useful in implementing semantic grammar and in coping with certain knowledge-representation problems.

Hearing It Talk

Converting text to natural-sounding speech is one of the functions of natural I/O. You may already have encountered applications of speech-output technology in automated voice mail, telephone directory assistance, and over-the-phone banking systems. And you may have listened to

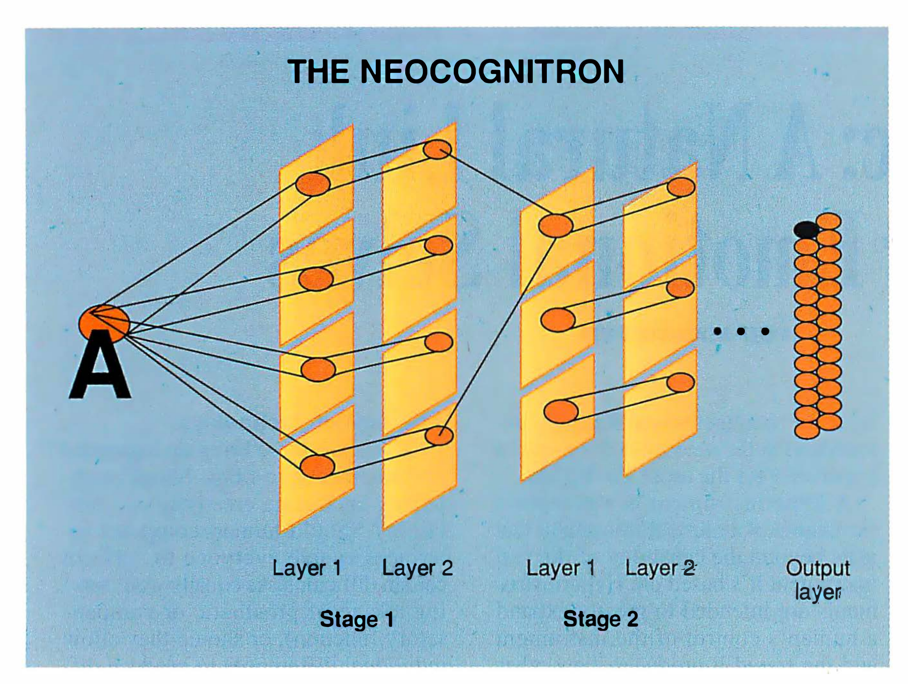


Figure 2: *The hierarchical neocognitron can recognize handwritten numerals. Each processing stage contains two layers of neurodes: One observes the previous stage's output, and the other provides limited translational independence of the image. Each successive stage detects higher-level features in the input image; the last stage makes the final character determination.*

digitized music output (e.g., background music) from devices such as answering machines and voice-mail systems.

The most natural-sounding text-to-speech systems available use digitized and edited human-voice recordings combined with pitch, intonation, and speed controls to generate fluent sentences. Individual phonemes and combinations of phonemes are recorded and edited for use as needed (see the text box "Toward Continuous-Speech Recognition" on page 158).

Natural-sounding speech is not easy to achieve because word intonation depends to a great extent on the context and meaning of what you say. English has many words that sound alike but have different meanings (e.g., *read*, which can sound like either *red* or *reed*), depending on the context. Further, for many speech-output applications, such as telephone directory assistance or automated banking, the text contains abbreviations, telephone numbers, and other nonword information. Thus, a good speech-generation system must perform some of the same syntactical and semantic processing that NLP systems do.

Once the system translates the text into the appropriate phonetics, it must convert these tokens to specific phonemes that the speech synthesizer can process. But this process can result in an atonal, artificial-sounding output unless the phonemes are further manipulated.

Individual phonemes are not the only factors that make speech sound natural. The transitions between phonemes add a natural flow to what you say. In addition, phonemes in human speech have varying durations in different words and sentences.

To compensate for these effects, many good text-to-speech systems use a rule-based system to help them determine the correct parameters for each sentence. The rules are based on the sentence structure of the message, and they help provide a humanlike sound.

Emotional Highs

Natural I/O deals with human emotions. One of the key ways humans express their feelings is through music. Computers of the future may have to accept, understand, and generate music to participate fully in this type of communication (see the text box "Music: A Natural Link to Our Emotional Selves" on page 137).

Many researchers have developed music-generation systems, using a wide variety of techniques. One example illustrates how such systems can learn to compose their own music.

Teuvo Kohonen began development of a unique music-composition system by analyzing the works of about two dozen composers, from Bach to Beethoven to Brahms. Out of these analyses, he created a collection of grammars that describe how each composer used notes, chords, and themes.

Kohonen trained a series of neural networks with these grammars; some trained on the grammar of only one composer, and others received training on grammars from two or more composers. Kohonen set up the networks so that they were given signals after training (the details of which Kohonen has kept private) that caused the networks to compose music in the style of a composer it learned from.

The music composed by the networks trained on one composer's grammar is fresh and pleasing. The music generated by networks trained on multiple composers, however, is extremely unusual and extraordinarily interesting, sounding much like a collaboration between, say, Mozart and Bach, or Brahms and Beethoven. Kohonen even has one network trained on all the grammars. That network generates an oddly atonal, quite modernistic music that has a peculiar appeal of its own.

This and other music-synthesis systems can provide computers with a range of emotional response, which soon may well match humans' natural expressiveness.

Reading Your Writing

As you consider the pen and pad in your Big Apple system, it occurs to you that people not only talk to each other, they also write notes. Handwriting recognition is another key form of natural input.

Using a keyboard is a skill that many people never acquire. But most children are taught to print and write. Thus, a computer that recognizes your handwriting is more natural than one that requires you to type in your commands.

Generally, there are two methods by which a system can recognize handwriting. One method is *dynamic recognition*, a process in which the system notes stroke sequences and uses that information to identify the characters. For example, a system might distinguish a capital *E* from a capital *B* in part by the order in which you make the character's strokes. Alternatively, you can use *static recognition*, a technique in which the system only receives the image of the finished character.

Static recognition can be more difficult than dynamic recognition because there is less information available to identify the letter you have written. Stroke order often gives clues to where each character starts and ends—clues that are missing in a static image of the final character. This problem, called *character segmentation*, is probably the most significant challenge faced when constructing a handwriting-recognition system.

Before they develop a handwriting-recognition system, vendors must decide if

they want it to recognize cursive writing as well as printed text. Most commercial systems process only printed letters.

Handwritten characters do not have a fixed size or position, and they can overlap each other in the field of view. They can be translated, rotated, misshapen, or incomplete—all of which makes it hard for the system to recognize the characters.

Neural Networks That Read

Researchers and developers have used a variety of neural-network algorithms to attack the reading problem, from the Reduced Coulomb Energy algorithm to back-propagation networks to the neocognitron (which was developed by Kunihiko Fukushima of Osaka University). A back-propagation network iteratively learns to recognize characters by adjusting the network's weighted connections using back-propagated errors. The neocognitron is a complex hierarchical series of overlapping feature detectors that identify images.

It has the ability to handle most translation and distortion variations with little or no preprocessing (but less success with rotated characters). It pays a price in complexity for this capability, however. A neocognitron network that can recognize only the 10 arabic numerals requires tens of thousands of connections and several layers of neurodes. To achieve such recognition capabilities, the neocognitron uses a complex hierarchical collection of *stages*. Each stage contains two layers of neurodes.

The first layer consists of neurodes that receive small overlapping segments of the image of the image-capture layer. These neurodes extract features from the image, and control neurodes embedded in the layer prevent each small group of neurodes from responding to more than one feature. The second layer of the stage provides limited translational independence by blurring the exact position of each detected feature (see figure 2).

The neocognitron idea is to extract more complex features at each progressive stage. The stages closest to the original image deal with low-level features; later stages handle more complex features and combinations of low-level features. This enables the final stage to identify the letter.

Neatness Matters

Other handwriting-recognition schemes frequently use similar designs, although the technology that is used may not be a neocognitron or even another neural-network model. As with other image-processing systems, the general rule is to determine low-level features, synthesize these into more complex features, and identify the image from this hierarchical series.

Except in the case of notepad computers, it's rarely sufficient for a handwriting system to recognize the writing of just one person. It usually must be able to process legible handwriting samples from many people. The greatest difficulty here arises from the large training sets required to provide good general recognition.

Because of this problem and the hardware limitations that require network development to be performed in software simulation, parallel network microprocessors that can learn on the chip are just now becoming available. Developing a neural-network handwriting-recognition system requires patience. Training can take weeks, and (depending on the network design used) the networks may never train well.

Taking Notes

Several products can recognize the handwriting of one person (sometimes of a few

people). Most notable of these are notepad computers, which use a stylus and a touch-sensitive screen that reacts to the user's handwriting. Such pen-based personal computers must interpret the user's handwriting and convert it into text, as well as process user interactions with software buttons and other interface elements selected by stylus touches.

Pen interfaces offer a number of advantages. You don't have to learn such "unnatural" skills as typing. Additionally, they are portable, and you can use them almost anywhere. Many businesses have found them to be very effective in situations where a lot of data is collected off-site and analyzed or used in other locations.

Disadvantages include having to deal with a system that holds relatively small amounts of data (handwritten text generally takes up more screen space than an equivalent amount of screen-font characters), and the necessity of training the system to recognize each person's handwriting. In addition, pen interfaces still can't reliably comprehend everyone's writing. If you scribble or use cursive writing instead of printing, there's a good chance the system won't be able to translate it correctly.

Notepad computers still make occasional errors, although at least one device uses a rule-based system to correct obvious typos and convert them into reasonable guesses. Among the extensions of these notepad computers are drawing-pad peripherals that let you draw on the screen using a similar pad-and-stylus arrangement.

The best of these drawing devices use a pressure-sensitive surface to relay relative-hand-pressure information to the drawing program. The graphics software uses that data to simulate an artist's heavy (or light) hand with a brush, a pastel, or a pencil. In the best cases, the resulting screen effects are almost indistinguishable from the variety of effects you can achieve with real-life painting tools.

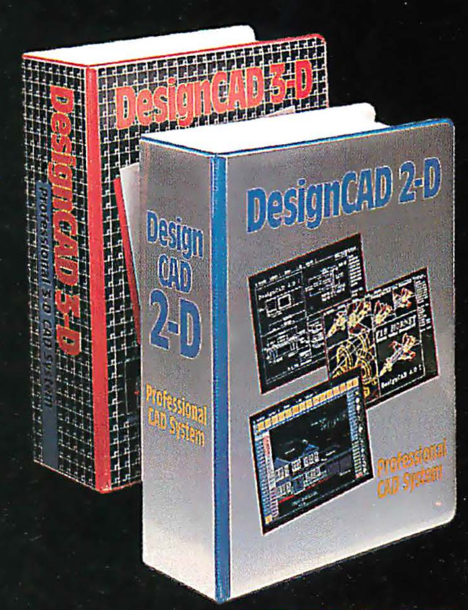
Body Language

Among the other obvious forms of natural input are biological feedback devices that deal with your hand and body motions (see the text box "Feedback Devices: The Human Machine Connection" on page 148). These particular inputs can be processed either through a direct connection between you and your computer (often using fiber optics) or by having your computer watch your motions and interpret them. The first kind of input is most common today, but some systems can also use intelligent machine vision.

In a body suit or glove, you literally wear the interface. Sensors attached to the fabric of the glove measure angular motions of your fingers, hands, arms, legs, or other body parts. In one product, VPL's DataGlove, the sensors detect the dimming of light passing through a short fiber-optic cable that is aligned over two knuckles of each finger. The cable must be accurately positioned over the center of each joint so that the cable bends when you flex the finger. The bending of the fiber-optic cable causes the light passing through the cable to dim, which provides a measure of the angular deflection of that joint.

A DataGlove subsystem determines the overall position of the hand. The motion of your hand through a magnetic field induces a current in three axial coils on the back of the glove. The magnetic field is generated by three similar coils on a stationary mount within about 3 feet of the glove. A small device mounted on the wrist detects the resulting currents, and microprocessors compute the hand's

GO FIGURE!





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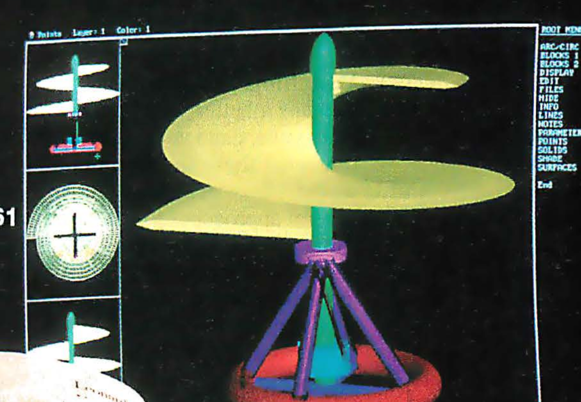
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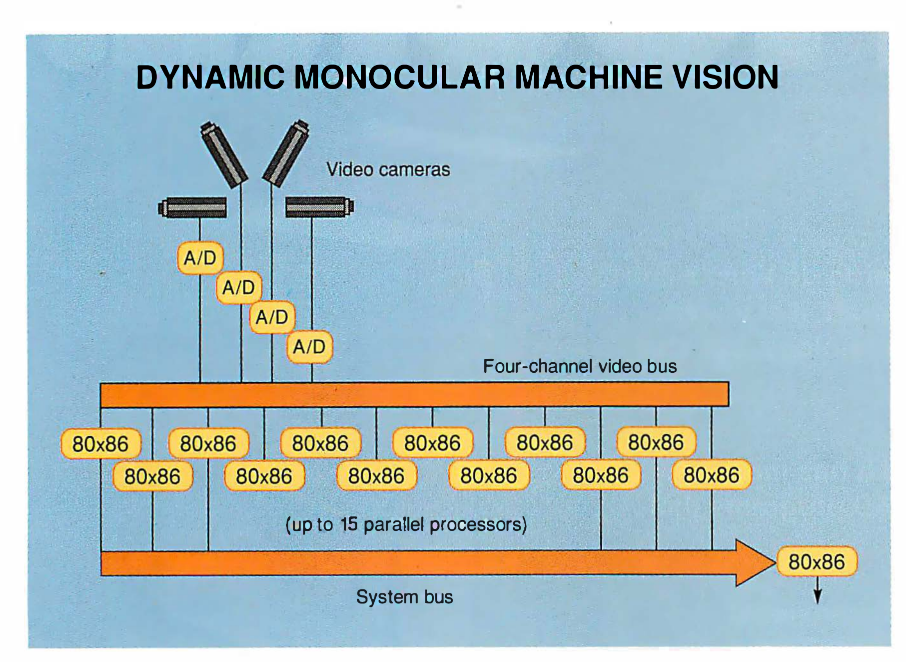


Figure 3: *Dickmanns and Graefe's dynamic monocular machine vision system uses custom hardware. The 286-based board has multiple processors that receive four video channels in parallel to provide a wider viewing angle. The on-board RISC controller chip performs many of the image-processing correlation computations.*

position within the field.

You must connect this system to a large computer that monitors, controls, and interprets the glove's sensor data. One of the greatest drawbacks to using this device is the physical constraints it involves. Not only must you keep your hand within range of the transmitter coils, but you usually must keep the other end of the glove's cable attached to a large computer that is not particularly portable. Other disadvantages of this kind of system lay in their inherent inaccuracies in measuring and interpreting data.

The most common body suits and gloves are made of stretchy lycra fabrics that fit tightly on the body or hand. The same fabric elasticity that enables you to put on the garment can cause the positions of the sensors relative to the joints and bones to slip and vary as you gesture and move. Some attempts have been made to overcome this predicament, including the development of Exos's Dexterous HandMaster (DHM), which replaces the glove with an external articulated cage.

To use the DHM, you put your hand inside an awkward-looking but lightweight and natural-feeling metallic articulated skeletal structure. The very nature of this design keeps the angle sensors accurately aligned with your hand and fingers. The result is more accurate input data. Furthermore, this design allows the DMH to detect side-to-side motion, using additional sensors. Overall hand position is determined using the same induced-current technology found in the DataGlove.

Other types of human-interface devices have been developed, and new, improved generic and application-specific equipment is evolving. The development of human-machine interfaces is a dynamic field, where researchers and vendors are rapidly making significant progress.

Watching You Move

Perhaps a better way to make your computer understand your gestures is to have it interpret them the same way a human would—by watching you move. There are several approaches to natural machine vision systems. In the long run, sophisticated machine vision systems may become more popular for natural I/O than the direct-wire link devices.

Interpreting gestures is not the same as identifying objects in a fixed-frame image. Hand and body movements are actions, and one way to interpret them is to use a dynamic machine vision system. Two German scientists, Ernst Dieter Dickmanns and Volker Graefe, have created such a system. Their dynamic monocular machine vision system provides human-like characteristics to interpret moving images. The ideas behind the system are both simple and profound.

First, assume the system has processed one frame of a movie and located a specific object using traditional image-processing techniques. To locate the same object in the next frame, it's not necessary to search the entire image. Because real objects don't blink in and out of existence, the most probable location of the object in the next frame is near its position in the first frame.

Using this insight, the Dickmanns and Graefe system localizes the search space for known objects from frame to frame. Rather than searching the entire image for the ball that was in the upper-right corner of the frame in the previous image, their system looks for the ball in a localized search box somewhat larger than the ball's position in the previous image. If it doesn't find the ball there, it expands the box until it locates the ball's new position. In a typical 512- by 512-pixel video camera image, this simple procedure can dramatically reduce the search time for all interesting objects in view.

Because the system is searching each local area for a specific object, its method of search can be optimized for that object. The system can scan the entire locator box using edge-detecting algorithms or another machine vision technique, or it can search the box by looking for a specific kind of surface. Dickmanns and Graefe noted that the human visual system is not perfect when exposed to objects that move rapidly in and out of view (see figure 3).

Although Dickmanns and Graefe have not applied their machine vision system to interpreting hand or body gestures, they have high hopes for its evolution into other related areas. For instance, it provides feature tracking in dynamic scenes, which is just what is needed for gesture interpretation and other applications in the natural-input environment.

A Smile Says It All

A key element missing from all these systems is the ability to perceive and interpret facial expressions. Much human communication occurs through smiles, frowns, and grimaces. The MIT Media Laboratory is a pioneer in this area of study.

Another research group—split between the University of California at San Diego and Dartmouth College—has trained neural networks to recognize facial expressions associated with specific emotions and to identify gender. These scientists used a series of standard 512- by 512-pixel video images of faces expressing emotions (e.g., anger, boredom, and astonishment). The images were reduced to 64 by 64 pixels by averaging the relative gray-scale level in each pixel and normalizing the brightness; they were then passed through a data-compression network. The I/O layers are the same size in this neural network—in this case, 64 by 64 neurodes—but the middle layer is significantly

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Circle 142 on Inquiry Card.

smaller. The idea is to train the output layer to reproduce the input image after it has passed through the small middle layer.

Once the data-compression system was able to accurately reproduce the original images, each image was passed through the network, and the resulting response vectors of the middle-layer neurodes were extracted. These compressed vectors became the inputs to a second two-layer network, which identified the emotion expressed by the person in the image.

The scientists achieved good research results. The neural networks were able to correctly identify most of the portrayed emotions, and when the network erred, the mistakes were usually similar to those human judges made on the same photos. In particular, the network more often confused negative emotions (e.g., anger, boredom, and misery) than positive ones (e.g., astonishment, delight, and pleasure). These results are consistent with those derived in human psychological tests.

Given an expanded, enhanced version of this technology, it is conceivable that your Big Apple computer may one day be able to tell when you're feeling blue and offer a cheery joke to lighten your day.

Reading Your Mind

The Big Apple system you purchase in 1993 includes a headband for you to wear, which provides yet another form of natural input: It can read your mind. You wear the headband (or skullcap, depending on design) so that the computer can monitor your brain waves and do what you mean instead of what you say.

Prototype telepathic controllers have already been constructed at the Nippon Telegraph & Telephone labs in Japan and at Stanford University in the U.S. The devices that users wear on their heads can be as simple as a headband or as complex as a lycra helmet. Sensors attached to the device detect the user's brain waves, just as an electroencephalograph detects brain waves (an EEG was the basis for many of the prototypes). The telepathic controllers usually transmitted a few dozen signals to a neural network for interpretation.

The neural networks train as a user concentrates on specific word commands, and the thoughts generate characteristic brainwave variations. Researchers are just beginning to learn how thoughts affect brainwave variations.

One or more neural networks interpret the signals and translate them into controlling commands. In one prototype system, a user was asked to concentrate on the words *left*, *right*, *up*, and *down*. The neural network (usually a back-propagation network) learned to interpret the brainwave characteristics of each word, and it associated them with the appropriate control commands for a joystick. The ultimate result: The joystick moved as a direct response to the user's thoughts.

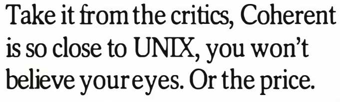
Several problems must be overcome before this technology becomes part of any commercial product: ensuring the precise positioning of the sensors on the head, shortening the response time of the system, and avoiding the necessity of training the system for each user. Also, it isn't clear how hard you must concentrate on a word to provide an adequate signal for the system to reliably detect.

Ubiquitous Computing

Your Big Apple computer is only one part of what has been termed *ubiquitous computing*. What this term means is that smaller, faster, cheaper, and smarter computers will become essential components of every

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item you deal with every day.

When this environment becomes commonplace, ordinary items will naturally adapt to you instead of your having to unnaturally adapt to them. You will become so used to this way of interacting with inanimate objects that you won't realize there is a computer inside them.

Xerox Palo Alto Research Center scientist Mark Weiser envisions such a day arriving perhaps as soon as the turn of the century. The scientists in his lab foresee computers embedded in objects at three different scales: inch-scale, foot-scale, and yard-scale. Inch-scale computers include microprocessors buried inside everything from identification badges to electronic chalk to paperless notes. These systems would connect via infrared links to other computers in each room of your home or in your office.

A room will contain countless small computers, none of which needs to be particularly smart. But when they are massively linked via wireless channels, your house or office becomes a place where electronic chalk writes on a yard-scale blackboard and your inch-scale coffee-machine computer asks if you want it to start your morning brew.

Note that many of these computers need recognize only "yes" and "no"; they do not need to understand language. To you, these devices operate as naturally as they always have, except that now your bulletin board displays information from across the country and your identification badge forwards your calls without any effort on your part.

Today's operating systems and networks, however, can't handle the loads needed to deal with the hundreds of computers that make up your ubiquitously computerized world. To implement this notion, we will have to solve significant problems in software and communications.

For example, operating systems will have to deal with hardware configurations that literally walk out of (or into) the system. And what happens when the window of an application has to move from computer to computer as you walk through a building? We must also enhance our networking technology so that we can seamlessly integrate wireless and hard-wired systems and cope with system configurations that change in the blink of an eye.

The World as You Know It

The last elements of your new Big Apple computer are the helmet and the goggles, with their wraparound three-dimensional display. These devices provide the ultimate in natural I/O—a virtual-reality environment (VR is an artificially generated domain in which you can experience and interact with a complete 3-D world).

The best-known example of this type of virtual space is often portrayed on "Star Trek: The Next Generation" in the Enterprise's holodeck. Simply by programming the computer, crew members can create the London of Sherlock Holmes's time, the Genesis planet, and any other place or time— real or imaginary.

Although the holodeck is fictional, simpler VR systems are already very real. Some of the first impressive VRs were the flight simulators used to train pilots. Using this technology, pilots can experience take-offs and landings, enjoy calm flights, and deal with emergencies. Through practice, they learn to handle airplanes skillfully in every kind of situation.

A good VR system uses some or most of the technologies I've discussed, but it adds at least one more: realistic, often 3-D

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Feedback Devices: The Human Machine Connection

BETH MARCUS

Imagine trying to pick a flower with one eye closed or grasp an egg wearing heavy gloves. That's precisely what we're doing in most computer applications. The link between the human and the computer can be either a barrier to productivity or a natural conduit for information and experiences. Now there are new, more natural ways for you to interact with your computer. Feedback technology is ready to reduce the barriers between you and your computer.

Pick any three-dimensional application and describe what you want to accomplish with it and what kinds of variables and objects must be manipulated, and you are defining the specifications for a feedback device. The applications that feedback technology can enhance are as varied as the applications of virtual reality (VR), 3-D graphics, and high-speed computing.

One of the research institutions now investigating teleconferencing, a feedback-technology application for use in business, is AT&T Bell Laboratories. Obviously, holding teleconferences would be easier and more practical if all parties only had to *feel present* rather than travel to various sites to hold critical meetings. This is just one area in which feedback technology can play a major role.

In medicine, the applications are many, varied, and increasing. Medical students and practicing surgeons must watch videos and observe actual surgery to learn new procedures. With VR, they will have an expert lead them through a procedure, and they can practice as often as they wish.

What's Out There?

Feedback technology has been evolving concurrently with the complexity and capability of computers and applications (see figure A). Following the development of this particular process, the technology diverged into two different directions: toward general-purpose and

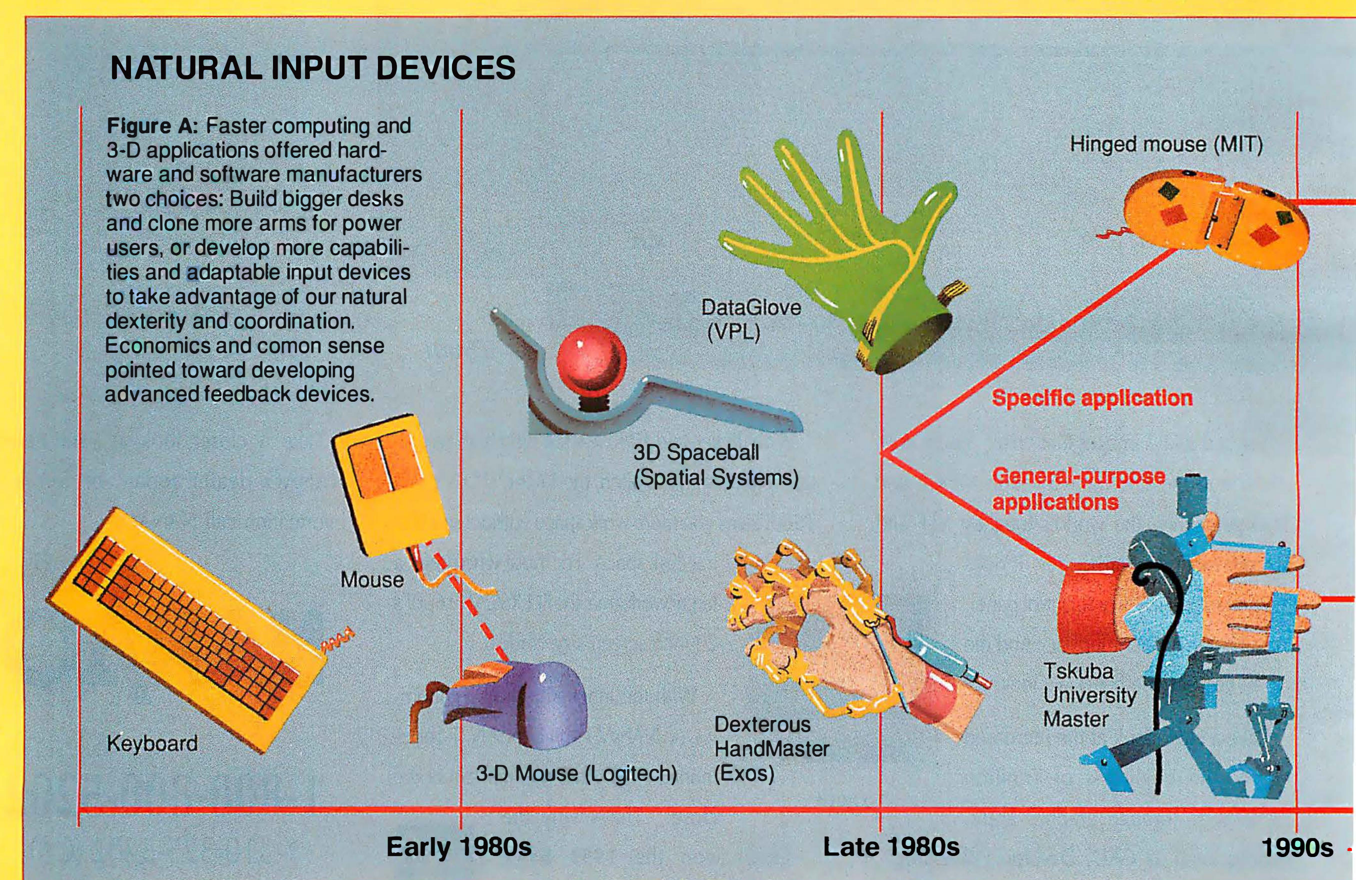


Figure A: Faster computing and 3-D applications offered hardware and software manufacturers two choices: Build bigger desks and clone more arms for power users, or develop more capabilities and adaptable input devices to take advantage of our natural dexterity and coordination. Economics and comon sense pointed toward developing advanced feedback devices.

special-purpose devices.

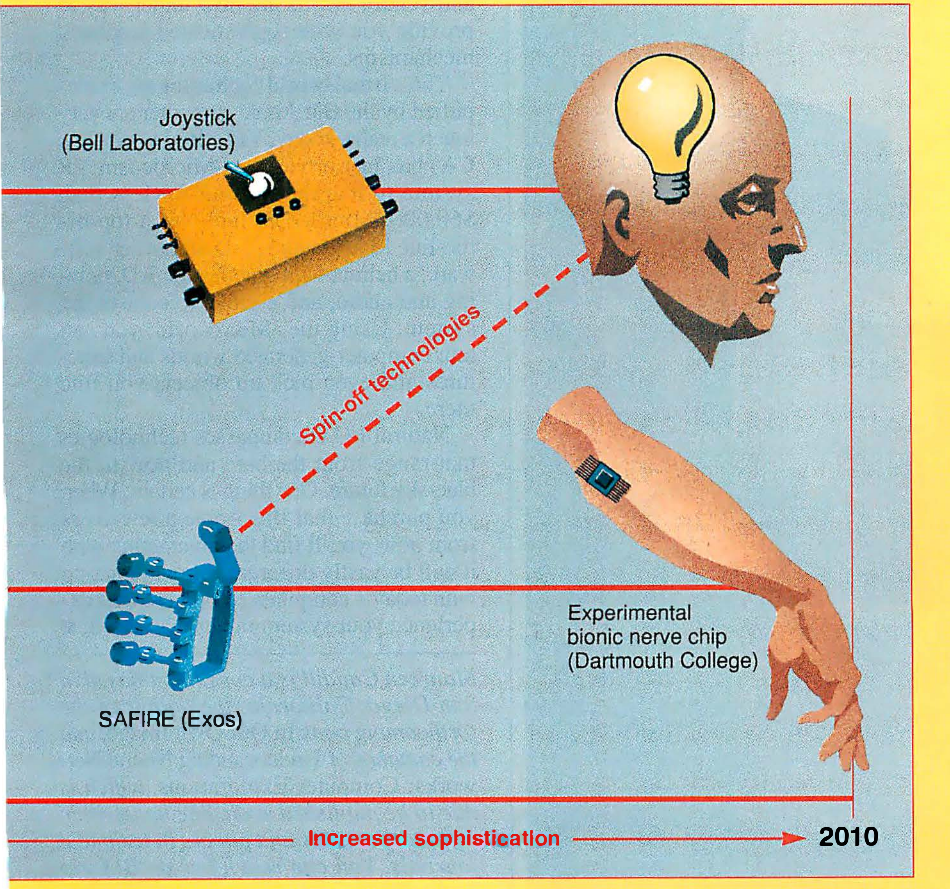
3D Trackers, a pioneering effort in the process, measure the position and orientation of a sensor-implanted object in free space. Three of the most widely used products are the Bird by Ascension, the 3Space Tracker by Polhemus, and the 3-D Mouse by Logitech.

To mold an object, manipulate something in your fingertips, or grab an object in a particular orientation, you are required to measure finger and hand motion. By identifying hand gestures and postures, whole-hand devices permit you to do that—and more. Some common examples are the VPL DataGlove, the Dexterous HandMaster (DHM) from Exos, and the Virtex Cyberglove.

Imagine inserting a key into a lock without feeling any contact or force. That's what it feels like to use most VR systems. But providing the sense of touch, motion, and force feedback is essential to accomplishing useful tasks with VR. If you take the DHM or any whole-hand sensor and add the TouchMaster (a simple tactile-feedback device), you have an inexpensive, easy-to-use method of displaying contact information. Exos has shown that tactile feedback can sometimes provide performance comparable to force feedback.

Force feedback has been around for a while in the world of robotics, but recently it has taken hold in virtual environments. Tskuba University researchers are developing a system to apply force to the thumb, two fingers, and the palm. The system is being used to preview new products.

The Sensing and Force Reflecting Exoskeleton is Exos's effort in this direction. The aim of SAFIRE is to provide accurate feedback to the free-moving hand without encumbering or restricting its movement.



Solving Specific Problems

Bell Laboratories has developed a high-performance, compact-force feedback joystick intended for engineering, business, and scientific applications. It could also provide an effective interface for disabled users. This device has been used to navigate through an electronics CAD program. It is not in production, but it could be priced within the reach of workstation or PC power users.

The MIT CAD Lab has developed a controller for sheet-metal design that is like a mouse with a hinge in the middle. Although the first prototype did not provide force feedback, that feature could easily be implemented. With evolution, this device could become a simple, low-cost method of specifying complex CAD shapes.

What's Next

Today, general-purpose feedback devices are probably not cost-effective or available enough to plug in and solve most problems. However, soon these devices will become lighter, more available, and more capable.

In the near future, equipment may exist that will resemble thin, flexible armor with embedded integrated sensor/actuator components. Then newly created techniques and technologies can be turned into a toolkit for designing application-specific devices that will effectively and economically solve problems.

Beth Marcus is president and founder of Exos (Burlington, MA), a company that manufactures medical measurement and rehabilitation equipment. You can reach her on BIX c/o "editors" or on Internet as bam@media-lab.media.mit.edu.

graphical computer output—natural output, if you like—to make the experience look and feel correct and complete. VR can also involve the use of data gloves and body suits, NLP, and sound generation. Some systems, like Autodesk, interface a stationary bicycle to the system so that you appear to pedal your way through a virtual world.

Because VR makes use of a combination of emerging technologies, it makes certain factors more important—for example, the key issue of *response speed*. This term refers to the speed at which the system can receive and interpret your input—whether it may be gesture, handwriting, speech, or thoughts—and react to that input by generating an appropriate output. Again, this output may be sound (e.g., speech, music, and sound effects) as well as text display or graphics. The response can also be a combination of some or all of these.

But don't confuse response speed with the raw sampling rate of each device. For example, the hand-tracking technology that some data gloves use is able to check the position of a hand approximately 60 times a second. However, internal processing performed by the tracker creates a lag of ¼ to ½ second between the input and when the information reaches the master computer. Therefore, there is a discernible delay between what you do and what you see and hear the system do in response.

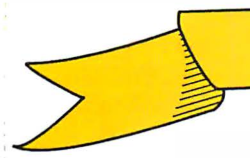
Another yet-to-be-resolved issue concerns your navigation and manipulation of virtual objects. The system must have prior detailed knowledge of how objects behave in the constraints of the virtual world they inhabit. If, for instance, you attempt to walk through a solid wall or into an empty space, your VR system should provide you with appropriate feedback to inform you that such movements are not acceptable—unless, of course, the VR is a fantasy world with walls you really can walk through.

If you reach for an object, the visual display must not only show you picking it up but also provide some resistance feedback (via the glove) that makes you feel the weight of the object in your hand. Today's technology is still perfecting ways to deal with this issue, but active research and vendor efforts are now under way to provide you with sophisticated feedback mechanisms.

The virtual-world technologies exemplified by the Big Apple computer are very much a reality today. VPL (Redwood City, CA) has just brought its Microcosm VR system to market. Selling for less than $60,000, Microcosm includes a top-of-the-line Mac Quadra, 3-D authoring software, a helmet with goggles for 3-D viewing and audio, and a glove to control the system. Using the Microcosm, you can tour computer-generated worlds and structures and even pick up objects you find there.

Natural I/O encompasses technologies that range from the here and now to the blue-sky future. One thing is certain: When you purchase that Big Apple a few years from now, you'll find that interacting with it will be vastly different from interacting with today's computers. You may well experience your system rather than use it. ■

Maureen Caudill is a consultant based in San Diego, California, the author of the forthcoming book In Our Own Image, *and the coauthor of* Understanding Neural Networks: Computer Explorations, *which is due to be published soon. She has written dozens of articles and papers in technical journals. You can reach her on BIX c/o "editors."*



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Of The Month From BYTE

First Aid for Viruses

A virus is a program that can reproduce itself. The virus program attaches itself to another program, usually an executable file. There are many different types of viruses and the symptons of a virus infection can vary widely. Generally a virus increases the size of a file. Some viruses display messages on your screen, or alter or delete files.

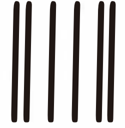
If you suspect that your computer has been infected by a virus don't use the computer. Physically disconnect it from any networks and

continued

don't use any floppy disks that have programs copied from the infected computer.

We recommend using a good antivirus program. For a review of antivirus software, see the August 1991 issue of BYTE (Rx for Safer Data, page 218).

For more information see Computer Viruses, by Dr. David Stang. This book lists some in-depth information about the viruses. Dr. Stang and Bill Bales head the National Computer Security Association (NCSA, 227 W. Main St., Mechanicsburg, PA 17055, (717) 258-1816). The association conducts seminars and provides information about computer security and virus protection.



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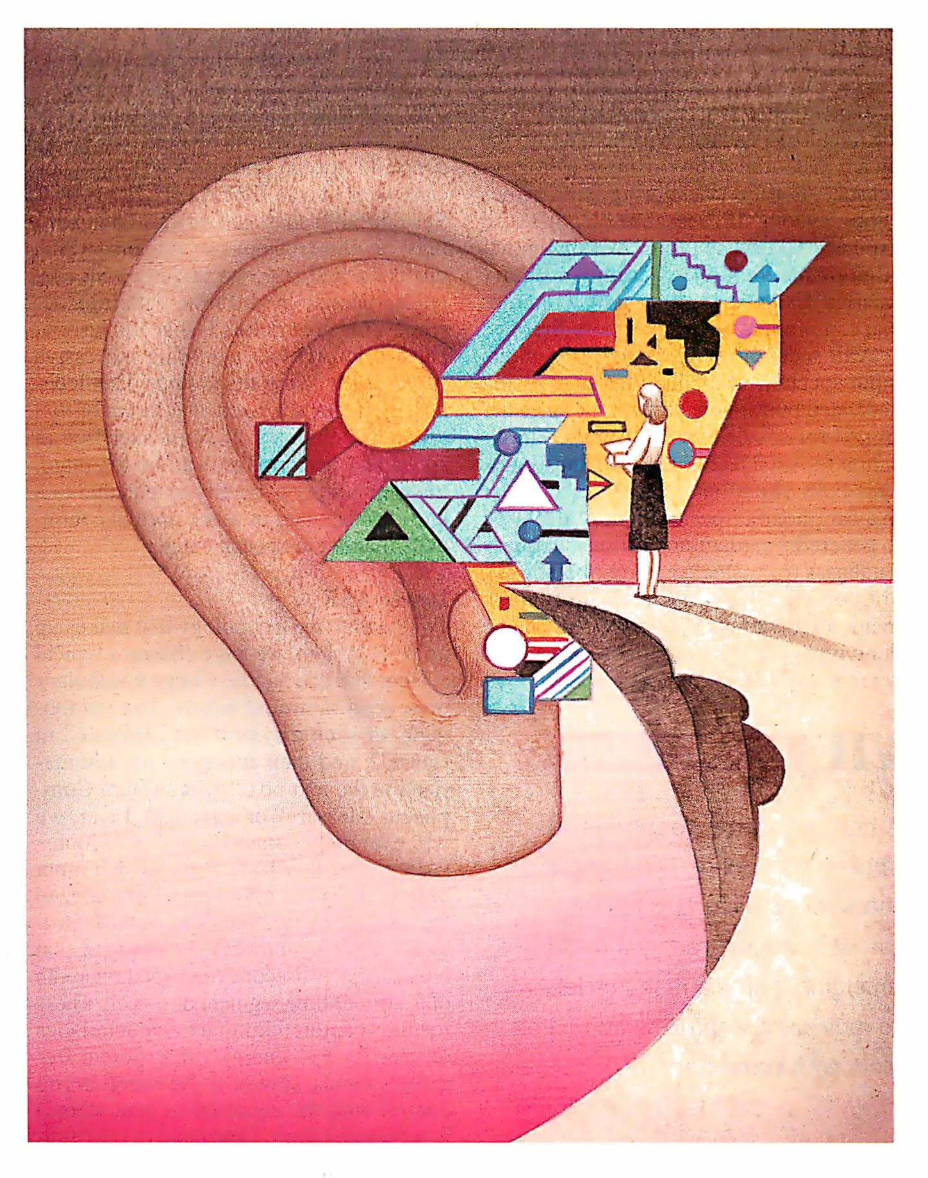
THE POWER OF SPEECH

Many people talk to their computers. Now, the computer may be listening.

SUBRATA DAS AND ARTHUR NADAS

The promise of ubiquitous automatic-speech-recognition (ASR) technology has been tempting people for two decades. Imagine your voice commands understood and obeyed and your speech transcribed automatically and instantaneously.

Today, ASR systems are used to ease or expedite many tasks. Systems that handle a small vocabulary of several hundred words or less are the most prevalent due to their ease of design. This article introduces a simple ASR configuration and cites examples of what you can do with this technology. After delving into some technical details about ASR, we will conclude by previewing some future possibilities.



Putting ASR to Use

Figure 1 shows a typical ASR configuration. The I/O interface consists of the usual assortment of devices (e.g., a monitor, a keyboard, and a mouse) but also contains a microphone for speech input. When you speak into it, the ASR system analyzes your speech, determines what you said, and displays the results on the monitor.

In addition to straight speech transcription, you can also use speech input to control or execute command functions. When entering the contents of a memo, you can create a new paragraph by uttering a command (i.e., "new paragraph"). Similarly, you can scroll up and down the screen or move the cursor using voice commands.

Ideally, an ASR system would work error-free under normal circumstances. But ASR technology is limited by the size of the vocabulary it can handle, the accuracy of its recognition, and other factors. Still, many of the applications within reach of today's technology are impressive.

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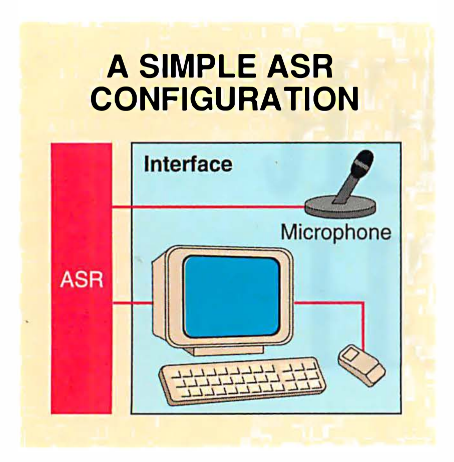


Figure 1: *To an ASR system, a microphone is simply another input device for a computer system.*

Consider an ASR-based medical reporting system. Promptly after examining an x-ray image, a radiologist normally must prepare a written report for the referring physician and the insurance carrier. The normal procedure of dictation by the radiologist and subsequent transcription by a typist—these days using a word processor—is time-consuming, sometimes taking as long as several weeks. It's also expensive, because typists with a knowledge of medical terms command hefty salaries. Using an ASR system, a radiologist can prepare a written report directly.

ASR technology lets medical workers input specialized medical terms by using dedicated built-in vocabulary modules designed for specific tasks. Another application for such technology is hands-busy, eyes-busy situations (e.g., a voice-dialer in a car phone). Speech input is also used to get credit-card authorizations, to query databases (e.g., stock-market quotations), or to access various business information in an organization. Such querying can be done remotely by telephone or in a conversational manner, where a speech synthesizer can enunciate the computer's response. ASR also promises to enable hearing-impaired people to converse over a standard telephone line by transcribing incoming speech and to eliminate the need to use a keyboard to create text documents (see the text box "Voice-Activated Word Processing" on page 156).

BYTE ACTION SUMMARY

A computer that responds to spoken commands is no longer the stuff of science fiction. Automatic speech recognition is emerging from the research lab to radically change how we can work with computers.

Voyager, an interesting experimental prototype of a conversational system, was developed by an MIT team as part of the Defense Advanced Research Project Agency's spoken language system program. Voyager can answer interactively some questions regarding hotels, hospitals, restaurants, and other establishments in a local area. If you ask, "How far is MIT?" it verbally asks for your present location before answering your question.

The Tangora system, an experimental prototype of a voice-operated typewriter for office applications, has come out of the pioneering work of a research group headed by Frederick Jelinek at the IBM Thomas J. Watson Research Center in Yorktown Heights, New York. Its vocabulary consists of 20,000 of the most common words found in office correspondence. Its special-purpose VLSI hardware card plugs into an IBM AT, PS/2, or RISC System/6000 chassis. Demonstrated publicly on numerous occasions since 1987, this is the first large-vocabulary ASR system to operate in real time with high accuracy. One restriction is that you have to pause briefly between uttering successive words when using the system. This technology is characterized as *isolated* or *discrete* speech entry. If some sacrifice in speed and performance can be tolerated, this technology is readily extendable to a larger vocabulary or to the normal continuous manner of speech entry.

Inside ASR

To illustrate the technology that makes up an ASR system, we have chosen a typical system that can handle a large vocabulary of several thousand words. The components of such a system are illustrated in figure 2, and their functions are summarized in the text box "ASR System Component Glossary" on page 154. Later, we will examine alternative configurations.

In a typical ASR system, speech input picked up by the microphone is analyzed by the signal processor. The analysis produces a set of numbers, or features, that represent a centisecond (one one-hundredth of a second) time segment of speech. These features capture important characteristics of speech (e.g., energies in different frequency bands, similar to the energies you control with the equalizer in your stereo) in a compact form. Generated every centisecond, they constitute a vector of speech parameters.

To understand the captured features, an ASR system uses a vector quantizer and acoustic-model and language-model parameters derived through design or training. The VQ parameters are templates for classifying different speech sounds that roughly correspond to the phonemes in spoken language (e.g., the \k\, \ae\, and \t\ of the word *cat*). ASR designers obtain the templates by examining several thousand vectors of speech parameters belonging to all sound categories that they want to incorporate in the system.

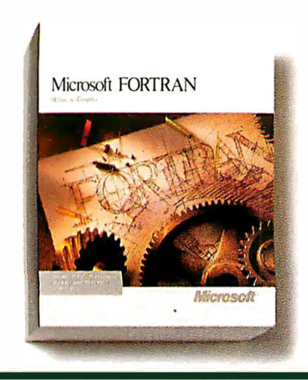
The output of the VQ reflects speech input by matching the incoming vectors against stored templates to determine the sound category of each centisecond. Thus, when you say "cat" to an ASR system, you will probably produce several instances of \k\ labels, followed by some labels of \ae\ and \t\, corresponding roughly to the times it took you to pronounce these sounds. However, because no one knows how to design a perfect VQ, the output of a typical VQ usually contains labels of similar sounds interlaced with the \k\, \ae\, and \t\ labels. Thus, you may find several occurrences of \eh\ (as in the word *pet*) and \uh\ (as in *cut*) labels, which sound similar to \ae\. In addition, transitional portions of speech (i.e., where the sound changes from one phoneme to another) tend to get mislabeled because the intermediate speech-parameter vectors poorly match the templates of either the preceding or the following sound.

Matters are complicated further because you practically never say a word or a sentence twice in the same way. Usually you are unaware of such diversity because of effective compensation by the human auditory system. Because this compensation mechanism is not well understood, these variations are usually attributed to noise in the auditory system. Thus far, the most successful approach to dealing with such noise is based on the hidden Markov model (HMM) principle rooted in information theory and statistics.

An HMM consists of hidden states (S), hidden transitions between the states, and observable outputs (L) associated with the states. In ASR, you assume that each state gives rise to one or more labels, or outputs (L): Each state accounts for one or more centisecond's worth of speech data.

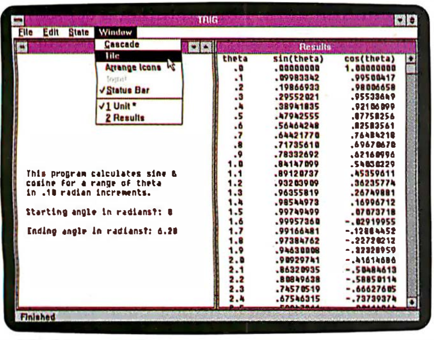
These models need two kinds of probabilities: transition probabilities for going from state S to state S' and output probabilities for producing the label L during such a transition. These probabilities are organized to form a transition-matrix (P||) and an output-probability matrix (||Q).

continued

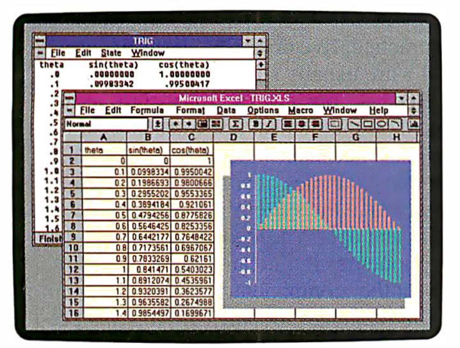




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PROGRAMMER'S TIPS

- *Use the new /MW option with the FL command to invoke the QuickWin library. For example: "FL/MW MYAPP.FOR" is all it takes to make MYAPP a Windows-based program.*
- *Use the ALLOCATE statement to dynamically size arrays and to access more than 16MB of memory on a 386.™*



ASR System Component Glossary

acoustic model—Models acoustic behavior of words by gluing together models of smaller units, such as phonemes.

decoder—Analyzes VQ label streams with the help of acoustic and language models to determine what was spoken.

interface—Contains I/O devices, including a microphone for user input to the ASR system.

language model—Models a language probabilistically based on context.

signal processor—Converts speech into a set of characteristic numbers at a regular interval, typically every one one-hundredth of a second.

vector quantizer (**VQ**)—Converts signal-processor output into a stream of labels identifying various sound categories.

Typically you start the model in a state at time 0. Now assume S_0 equals 1, and imagine that at times 1, 2,...*T*—some sequence of states $S_1, S_2, \ldots S_T$—is traversed. The state after state *S* is chosen according to the probabilities in row *S* of the matrix *P*||. This is the *Markov property*. The label *L* produced at this time is chosen according to the probabilities in ||*Q*.

To apply the HMM principle to acoustic modeling in ASR, you first represent each word in the vocabulary of the system with a *baseform*, or a string of phonetic symbols specifying the cardinal pronunciation for the word. The baseform for *cat*, for example, would be \k\ \ae\ \t\. Each phonetic symbol is viewed as an HMM whose output corresponds to a part of the stream of labels received from the VQ. The model for a word is constructed by combining HMMs for the phonemes.

Speech Training

The probabilities associated with HMMs are estimated from training data obtained by reading a known script. The method for this estimation is known as the *maximum-likelihood principle*, which maximizes the probability of the data as the statistical parameters of the assumed HMMs vary. The maximization is performed by an efficient iterative training procedure invented by L. E. Baum and his colleagues at the Institute of Defense Analyses, and the procedure is variously known as the Forward-Backward, Baum-Welch, or Expectation-Maximization algorithm.

The statistical parameters that an ASR system has to learn are the transition probabilities (*P*||) and the output probabilities (||*Q*) of the various models. If the hidden states were observable, this training would be very simple. The estimate of any transition probability would be the fraction of the number of times the transition occurred. Similarly, the estimate of any output probabilities would be the fraction of the number of times a particular label occurred. Because states are hidden, however, the training algorithm cannot make such straightforward extrapolations.

Training algorithms do the next-best thing—they compute these fractions using estimates of the hidden numerators and denominators. For example, a typical training algorithm might consist of the following steps:

1. *Initialization.* Fix reasonable initial values for each of the transition and output probabilities.
2. *Expectation.* Using the last estimates of all probabilities, compute the expected value of all counts of numerators and denominators.
3. *Reestimation.* Reestimate each probability as ratios of the expected values in the expectation step.
4. *Iteration.* Jump to the expectation step or stop.

In practice, five or six iterations of steps 2 and 3 are usually sufficient.

Because our primary modeling unit is based on phonemes, not words, the training data need not (and usually does not) contain examples of each of the thousands of words in the system's vocabulary. Only sufficient data is needed to model the 50 or so phonemes in the language.

Another component of our ASR system is the language model, which helps predict a future word based on past input words. For example, if the Shakespeare in you recites, "To be or not to," and then says "be," the ASR system should understand that you mean *be*, and not *bee* or *B*. The language model makes such decisions with the help of probabilities that reflect how often a word appears in a given context. For instance, *bi-gram* probabilities represent this context in terms of word pairs. The system precomputes probabilities by examining a body of text containing several million words.

The last component of an ASR system is the decoder, which examines the input stream of VQ labels and applies acoustic-model and language-model probabilities to convert the label stream into a sequence of words. A two-stage operation is typical. The first stage is a quick approximate search to trim down the list of potential

Figure 2: *The components of an ASR system work in synchrony to produce the best possible interpretation of speech input.*

Voice-Activated Word Processing

RAYMOND C. KURZWEIL

Three years ago, the only people using large-vocabulary automatic speech recognition to create written documents were technology enthusiasts, including a number of speech-recognition developers. Today, large-vocabulary ASR has moved significantly beyond these classical early adopters, and it's used by thousands of people every day to create professional reports.

These users (most of them doctors) benefit from the integration of robust large-vocabulary ASR with an expert system for creating reports in specific domains. These systems combine a free-text mode for general-purpose dictation with detailed knowledge bases (in such areas as emergency medicine, radiology, and pathology) to assist rapid dictation of structured reports.

Large-vocabulary ASR has also found acceptance by hands-impaired individuals. Products for this population have been marketed by Kurzweil Applied Intelligence (KAI), Dragon Systems, and IBM.

ASR technology has always benefitted from high processing speeds and lots of megabytes of storage, and the ongoing geometric advances in semiconductor technology have been very much in its favor. With 20-million-instruction-per-second personal computers a reality and 100-MIPS personal computers waiting in the wings, you will see continued progress in the viability of ASR over the next several years. Knowledge-base applications will continue to evolve, with applications developing outside medicine in such areas as law and financial services.

Of particular significance to the average computer user will be the emergence of viable voice-activated word processors (VAWPs) for general-purpose text creation. Key to this application is a very large vocabulary (on the order of 50,000 words), true speaker independence (i.e., the ability to recognize a user's voice without previous exposure to that voice), high accuracy, and noise immunity. Such systems will combine the ease of use and the speed advantage of dictation with the immediate inspection and error-correction power of the keyboard. Not all people have keyboard skills, but most of us readily communicate through speech.

KAI is progressing toward the VAWP. It's working on a discrete-speech ASR system with a 50,000-word vocabulary (40,000 core words and the ability to add 10,000 user-specific words) and quickly accessible knowledge of 200,000 words. The system is speaker independent for most users, although it improves its performance as it adapts to a particular user.

In a joint project with Fuji and Xerox, KAI has also developed a large-vocabulary continuous-speech system for Japanese. Because of the enormous size of the kanji character set (over 7000 symbols), the Japanese have greater difficulty than English-speaking people do in entering text by keyboard, so large-vocabulary ASR will be particularly useful with the Japanese language. Late last year in Tokyo, KAI demonstrated a research system that recognizes continuous speech in near real time and has a 20,000-word vocabulary. KAI is also adapting similar techniques toward development of a fully continuous, large-vocabulary English system.

Speech is our most powerful way of communicating, and it has long been assumed that ASR will ultimately be a ubiquitous interface between man and machine. The only question has been when suitable ASR technology would become available.

There already are thousands of users who are harnessing this technology to create most of their written documents. As a result of strides made in ASR algorithmic development and the stunning pace of the semiconductor revolution, you will see increasing acceptance of ASR as an input method in the years ahead.

Raymond C. Kurzweil is the founder, chairman, and co-CEO of Kurzweil Applied Intelligence (Waltham, MA). He has been a pioneer in the area of speech-pattern recognition since the mid-1970s. You can reach him on BIX c/o "editors."

words. The second stage is a more thorough search. The search strategy takes advantage of the stack-decoder algorithm.

The decoder computes probabilities of word strings (partial and complete sentences) and searches for the most probable complete sentence given the speech data (i.e., the string of labels produced by the VQ). The decoder maintains a stack of partial sentences, with the entries ordered from the top down in order of decreasing probability. A special end-of-sentence word must be at the end of each sentence. The stack entries are extended one word at a time, and the stack is reordered. The process stops when the top of the stack has a word string with an end-of-sentence word. This word string is the decoded sentence.

Combine all these components, and you have a user-ready ASR system. When you speak, the signal processor puts out speech-parameter vectors every centisecond. The VQ receives them and emits a stream of labels for the decoder. The decoder analyzes these labels and attempts to determine the sequence of words that you said.

Limitations of ASR

Ideally, an ASR system would have an unlimited vocabulary, allowing you to say any word that comes to mind. In reality, practical considerations limit your options. Large vocabularies tend to increase the error rate and processing time.

When the vocabulary is sufficiently small (i.e., limited to several hundred words or less), simpler systems based on dynamic programming matching are often adequate. Such systems use a matching procedure between speech-parameter vectors of two utterances that have time segments that can be deleted or extended to accommodate normal temporal variations in the utterances. To apply this matching, you ensure the beginning and the ending

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Values in watt/(cm·K)

T(K)	Aluminum	Cadmium	Chromium
1	7.8	48.7	11.401
2	15.5	89.3	0.082
3	23.2	104	1.20
4	30.8	92.0	1.60
5	30.1	69.0	1.99
6	45.1	44.2	2.30
7	51.5	28.0	2.77
8	57.3	18.0	3.14
9	62.2	12.2	3.50
10	66.1	8.87	3.85
11	69.0	6.91	4.10
12	70.8	5.56	4.49
13	71.5	4.67	4.70
14	71.3	4.01	5.04

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$$f(T) = \frac{9.1 \cdot T}{1 + 3.1 \cdot 10^{-4} \cdot T^{3}}$$

Thermal Conductivity of Aluminum

80, 60, 40, 20, 0; 0, 30, 60, 90, 120

Page 1 auto

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Toward Continuous-Speech Recognition

BART VERHAEGHE

Continuous-speech recognition on a personal computer is the use of natural, fluent speech to input text or a command (e.g., open a file). The various methods used to implement this technology are based on three primary techniques: speaker-dependent, speaker-adaptive, and speaker-independent recognition.

Many commercial products feature continuous-speech recognition, but they use only the speaker-dependent and speaker-adaptive methods. The process of training involves pronouncing words or phonemes for the computer and correcting its speech-recognition errors until it becomes familiar with your voice.

Speaker-independent recognition lets anyone use voice commands without specific training. Lernout & Hauspie Speech Products in Belgium has produced such systems for English, French, and Dutch, and it's working on Spanish, German, Italian, and Japanese versions. A system demonstrated by the company recognizes 2500 speaker-adaptive words and 200 speaker-independent words.

Speaker-independent phoneme recognition lets you easily modify the set of words to be recognized. An automatic text-to-phoneme algorithm converts words into their corresponding phonetic transcriptions. The phoneme templates are concatenated to form the new word template. Text-to-phoneme conversion is part of the linguistic processing in speech synthesis. (See "Even as We Speak" on page 165.) Companies that develop speech synthesis and speech recognition combine the two technologies for this reason.

Until now, speech recognizers could not distinguish between relevant and irrelevant information. *Word spotting*, a technique that allows users to speak fluently and naturally to a computer, helps them make this distinction. Both Bellcore and Lernout & Hauspie are developing this technique.

For example, starting an application under Windows could sound like, "Please start...euh...spreadsheet." The command is recognized as "start application spreadsheet." Word spotting allows the system to detect keywords in continuous-speech input strings; you don't have to pronounce the commands exactly or as discrete utterances. Coughing, background noise, and irrelevant words don't result in the recognition of a wrong command.

Word spotting is useful for command and control applications, although it cannot be used for the dictation of large vocabularies. The larger the vocabulary, the more complex the linguistic knowledge involved becomes. For example, transcribing "two plus two equals four" involves (among other things) distinguishing *two* from *to*, *too*, or *toe* and recognizing the difference between *four*, *for*, and *fore*. Semantic analysis calculates the highest probability of correct interpretation in the context of usage. In this example, the words *plus* and *equals* determine the correct recognition of *two* and *four*.

The future of continuous-speech recognition will be in speaker-independent continuous-speech recognition with large vocabularies. Making machines that can recognize any speech from any person, without training, is at least five to 10 years away. In the meantime, useful applications of the technology are emerging. As personal computers become more powerful and the price of digital signal processor power and memory drops, your own voice will become the ultimate input device.

Bart Verhaeghe is manager of U.S. operations at Lernout & Hauspie Speech Products. He has been working in the speech I/O field for four years and is a speaker at the American Voice Input Output Society's voice and speech technical conferences. You can reach him on BIX c/o "editors."

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segments of the words remain unchanged and adjust the intermediate time segments within certain constraints to achieve an optimum match.

Recognition systems typically work much better if you input isolated words as opposed to a continuous word stream (see the text box "Toward Continuous-Speech Recognition" above). Also, speaker-dependent systems (i.e., where the VQ templates and acoustic model probabilities are tailored to each user after being trained with some of the user's speech) generally outperform speaker-independent systems (i.e., where parameters are based on a common pool of data from several speakers).

Another approach is to start with the recognizer on a speaker-independent footing and adaptively improve its performance during operation by continually modifying the parameters to suit the characteristics of the user. Language-model probabilities can also be updated to capture the composition style of the user.

In laboratory studies of speaker-dependent 20,000-word ASR systems, we typically register 98 percent word-accuracy rates with isolated-word speech input and 90 percent accuracy rates with continuously spoken utterances. Problematical factors for ASR include sounds of lip smacking, breath noise, and the "uh" and "um" sounds that many people produce unconsciously. Background noise and speech entry through a telephone line tend to degrade the performance as well.

Speech recognizers make mistakes, and you need an efficient way to correct them. This is where some human factors surface. Would you prefer to correct an error as soon as it's made or to wait until the document is complete and then proofread it?

continued

Circle 94 on Inquiry Card.

THE POWER OF SPEECH

Do you prefer to use voice commands or a keyboard and mouse to negotiate your cursor to the erroneous word? These are just a few of the questions faced by interface designers of ASR systems.

There are many other ways to design an ASR system. Signal processors in some ASR systems derive parameters (e.g., linear predictive coefficients) that attempt to capture speech characteristics in the time domain rather than in the frequency domain. If the background is noisy, a noise-adjustment scheme may be needed to maintain good system performance. Some ASR systems use speech parameters directly for acoustic modeling and decoding, bypassing the VQ step. The language model in some cases can be implemented in a more traditional linguistic framework. Another discipline under study for speech recognition is artificial neural networks.

ANNs for ASR describe x, y plots, where x is speech and y represents a range of some interesting linguistic objects (e.g., words, phonemes, and labels). Given speech x, the ANN chooses a word y. The word *neural* in ANN is derived from similarities (not to be taken too seriously) between the ANNs and the way biological neurons are connected to each other. An advantage that ANNs offer over HMMs is that any set of characteristics can be well approximated with ANNs. An advantage that HMMs offer over ANNs is better time-warping ability. The jury is still out on which technique delivers the best results.

What's Next?

Scientists are busy trying to overcome the limits of ASR technology. Projects dealing with issues such as speaker independence or adaptation, continuous speech, unlimited vocabulary, and noise immunity are under way. Commercial systems are already integrating speech recognition into everyday applications. In a related area with vast potential to augment international communication, researchers are developing techniques to automatically translate speech over the telephone from one language to another. A speech synthesizer can be used to reproduce the translated version, preferably in the user's own voice.

Based on the progress achieved over the past decade or so, we expect that these issues will be substantially resolved by the dawn of the twenty-first century. ■

Subrata Das and Arthur Nadas are researchers in the Continuous Speech Recognition Group at the IBM Thomas J. Watson Research Center (Yorktown Heights, NY). You can reach them on BIX c/o "editors" or on Internet as das@watson.ibm.com and nadas@watson.ibm.com, respectively.

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✔ Unbreakable electronics. A customized ASIC (Application Specific Integrated Circuit) component should be integrated in the key. This prevents reverse engineering and makes cracking virtually impossible.

✔ A unique and inaccessible software developer's code burnt into the ASIC. (This code should not be held in the key's memory, where it can be read and altered.)

✔ A Read/Write Memory inside the key should be available on demand. The memory should be writable in the field, on any PC, without any special programming equipment.

✔ Very low power consumption, enabling the key to work even under the worst power conditions, on PCs and laptops, with or without a printer.

POWERFUL SOFTWARE

Since it's practically impossible to crack or duplicate a key having all the features mentioned above, a pirate will usually go for the software linking the protected program to the plug. Therefore, check that your protection software has all of the following:

✔ A Linkable Protection Module with which calls can be made to the key from any point in the protected program.

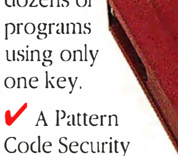
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* CT Magazine, May 1990.

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EVEN AS WE SPEAK

The use of voice synthesis delivers the world of computer information in a natural form of human communication

JOSEPH J. LAZZARO

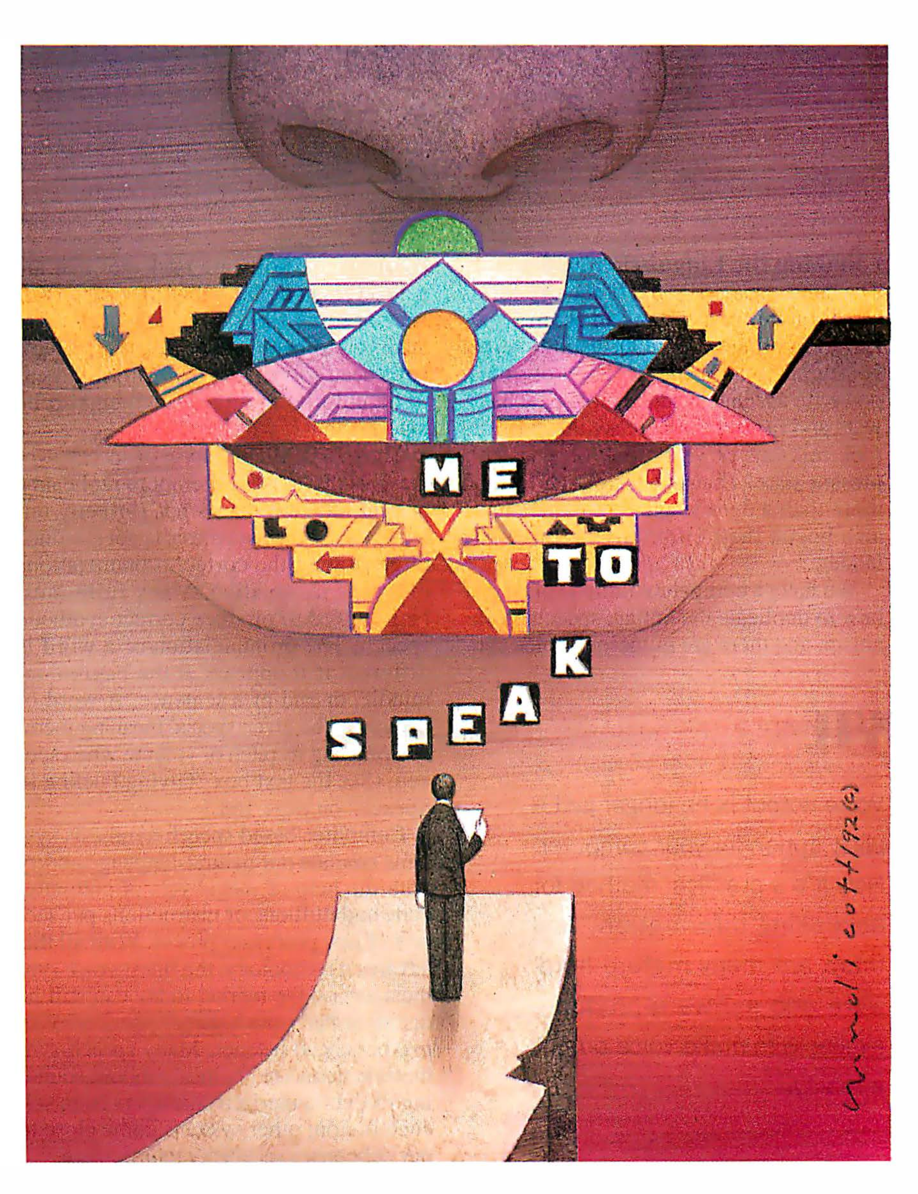
The fax you've been waiting for all day hasn't arrived. It's six o'clock; you know it's coming—soon. You have spent many nights like this chained to your office, but tonight is different. You grab your coat and head to the car. Dinner is at seven, the kids' school play is tonight, or you have a stress headache—all good reasons why waiting around the office for a fax that could affect the rest of your career is out of the question.

After 15 minutes of sitting in traffic, you dial into your new voice-automated fax machine. You punch in your code number, and the machine replies, "I'm sorry; there are no new fax messages in your in basket." You try again 20 minutes later. The same pleasant-sounding semirobotic voice confirms there is a fax transmission addressed to you, and it reads you the message's contents as it simultaneously prints a copy of the message on your printer. No more long, lonely nights in front of the fax machine.

As personal computers continue their evolution, it's only logical that they be granted the power of the spoken word through speech synthesis. Speech synthesis is the artificial generation of the spoken word using computer-based hardware and software.

If you tend to view the development of computers in biological terms, the electronic species are gaining more flexibility as their I/O devices continue to acquire greater capabilities. If you carry this idea to its limits, the ultimate natural I/O system for a computer is voice recognition combined with voice synthesis, because it emulates our own normal communication methods.

continued



The typical personal computer can be fitted with speech by merely adding a circuit card or external voice box and the appropriate text-to-speech software to make it all work together. There are even speech-synthesis products for laptop and notebook computers, making these portable machines efficient talkers as well. Even the GUI is starting to become verbal as speech packages designed for these systems hit the market.

Speech synthesis is valuable in a telephone environment, where video screens are not present to display information to you. Unlimited-vocabulary text-to-speech systems are important for verbalizing large, dynamic databases.

Speech is capable of verbalizing the contents of a computer screen for those unable to read because of vision or learning problems. Speech can also add life and emphasis to multimedia applications, as color text and graphics combine with natural-sounding voice output to create user-friendly applications. With all this in mind, I'll take a look at how a typical speech-synthesis system works.

Climbing the Linguistic Ladder

The human species is one of the rare forms of life on this planet that can claim a spoken form of language. Our natural verbal ability has often been declared our most powerful attribute, and the biological hardware and firmware that make this possible took millions of years to evolve to their present state. Thanks to R&D performed more than a decade ago, computers have also begun their climb up the linguistic ladder.

We have a competent understanding of how to duplicate the human speech mechanism, and there are numerous voice synthesizers and software packages that are a direct result of this knowledge. The presence of dozens of speech products might lead you to believe that all the problems have been solved, but there are still areas to be colored in and refinements to be made.

The most difficult aspect of speech synthesis is that it is an attempt to replicate a human function that is not perfectly understood. Speech synthesis is not confined to generating the correct pronunciations of words in isolation. Many rules must be followed to produce correct synthetic speech. The pronunciation of a word is different if it appears at the beginning, middle, or end of a sentence. A word or phrase can be given special meaning merely by raising its pitch or volume when spoken. (See the text box "Giving Feeling to Speech" on page 168.)

Computer-based speech-synthesis systems emulate our natural-language ability with the help of megabytes of computer code and millions of instructions per second of raw processor power. With all this advanced technology, the finest voice synthesizers on the market today can still be distinguished from a human speaker by an inexperienced listener. Many speech-synthesis systems are obviously robots, sounding like computerized characters from science fiction; other systems come close to our subconscious ability to articulate.

BYTE ACTION SUMMARY

Voice output is no longer just a glitzy option for your computer. Now it's a practical method for accessing information, and there are many mature hardware and software products available to make voice output a reality.

Worth a Thousand Words

A speech synthesizer is essentially a dedicated microcomputer that is committed to running its text-to-speech software. It can come bundled as an internal circuit card capable of being plugged into the bus slot of most personal computers. Voice synthesizers can also be external units designed especially for serial or parallel interface ports.

Voice synthesizers contain many of the same components found in microcomputers. These include RAM for running the text-to-speech software, which is loaded into the system memory from floppy or hard disks.

The more powerful speech units include an on-board microprocessor, which provides enough computing power for their operation and takes a significant amount of pressure off the host microcomputer system. Voice synthesizers also contain digital signal processors (DSPs) to crunch the sheer bulk of numbers necessary to re-create the complex waveforms that make up human speech. The D/A converter is also a major player in many speech-synthesis products, because these dedicated chips reproduce complex waveforms based on high-speed digital signals.

The DECtalk PC is a high-end internal speech synthesizer and a self-contained microcomputer in its own right. The board is based on the previous DTC01 synthesizer and has nine different voices on-board. The heart of the system is an 80186 microprocessor, a megabyte of RAM, and

a Texas Instruments (TI) TMS320 DSP. The DECtalk PC can speak at a rate of 120 to 550 words per minute and contains more than 1400 letter-to-sound rules.

Street Electronics' Echo PC II is another example of an in-board speech synthesizer for AT-bus computer systems. The synthesizer has an unlimited vocabulary and comes bundled with an external speaker and text-to-speech utilities. In addition to generating speech by rule, the board can also play back digitized sound samples.

The Echo contains a TI TMS50C10 sound chip and a 2-watt audio amplifier. The board can play back 10-bit sound samples at rates of 8, 9.6, and 11 kHz. The Echo can also play back 8-bit samples at rates of 16, 19.2, and 22 kHz. The bandwidth of the Echo synthesizer is about 100 to 4500 Hz. This board is well suited for the programmer who wants to build speech applications, because it's inexpensive and well supported.

Street Electronics is about to roll out a new version of the Echo PC aimed mainly at persons with vision impairments. This synthesizer is portable and powered by a standard 9-volt battery. It's driven by a Motorola 6805 microprocessor and contains 32 KB of internal ROM. The synthesizer can be driven by any serial port capable of communications at 9600 bps.

The unit will come with a headphone, a jack, and text-to-speech software in firmware. Street Electronics hopes to sell the unit for less than $150. The company also has plans to roll out a clone of the popular Sound Blaster that is capable of performing synthesized and digitized speech functions.

The Mac has its own built-in speech hardware and software, and it was one of the first successful platforms to accomplish this feat. The Mac comes from the factory with a built-in text-to-speech program called MacInTalk, which drives the built-in speech hardware and is capable of generating an unlimited vocabulary. The new Mac platforms also come bundled with a built-in microphone, which makes it easy for developers to create custom voice applications.

The Amiga also comes out of the box with built-in speech capability, and files can easily be dropped into the voice module for reading with an unlimited vocabulary. The speech-output system for the Amiga is part of the operating system, which makes it accessible to programmers interested in incorporating speech into an application.

Speak to Me

The complex process for converting text to speech requires multiple layers of intelligence. Because speech synthesizers are dedicated microcomputers designed to produce speech, their software can be designed to run on specific boards for maximum efficiency. Speech software can also be written in languages that can easily be ported to different systems, making it possible to take advantage of different microprocessors and hardware configurations across platforms.

The software is often broken down into tasks, with each job assigned to one or more modules. These duties include normalization of the incoming text information, conversion of text to phonemes, and processing for sentence and accent stress. These modules work hand in hand, with the output of one module providing the input for the next.

Many speech systems are based on the three-tiered approach developed by Dennis Klatt at MIT. Refinements have been made to this model over the years, including stress parsing and larger dictionaries.

The first software module in a typical text-to-speech system is known as a *text normalizer*. This module is the entry point for incoming ASCII text, and it's responsible for converting the printed word into a form compatible for voice output. The text normalizer strips punctuation from the incoming text, and it converts numbers to words and changes dates to a more pronounceable format.

For example, the dollar amount $19.95 would not be verbally expressed comprehensibly in its current form. As the figure is written, it would be pronounced "dollar sign one nine point nine five," which would be difficult for a listener to comprehend. The text-normalizer software would convert this phrase to a more manageable form, such as "nineteen dollars and ninety-five cents," resulting in a more easily understood phrase.

The next module to come into play is the *lexicon*, which is responsible for stripping suffix and prefix information from incoming words. This is done to determine the root word so that it can be more easily found in a text-to-phoneme directory. If the lexicon saw the word *goodness*, it would convert it to *good*, greatly simplifying the directory search. The lexicon is useful for weeding out letter combinations that are not true words (e.g., IBM and FBI).

The subsequent program module is the *phoneme converter*, which translates the incoming text from the previous module into phonemes using a RAM-resident dictionary. A phoneme is the smallest sound byte of a language, and English contains about 40 phonemes.This dictionary simplifies the text-to-speech process greatly, because it can guide the synthesizer to perfect pronunciation for the most common words.

The next program segment is *intona-*

Giving Feeling to Speech

JAN ZIMMERMAN

From the subtly sarcastic voice of HAL in *2001* to the subtly sultry voice of the computer in *Star Trek: The Next Generation*, fictional computers speak as if they are your best friend—or your worst enemy. How disappointing to hear nonfictional computers speak in a scratchy voice with the monotonous pace of a marching army on a long, long trek. Thanks to market demand and advances in text-to-speech synthesis, however, the picture is changing.

The advent of hand-held devices that speak, ranging from foreign-language translators to the Bible, has created a demand for an authentic voice. Without natural-language parsing, however, these types of synthesized voices simply consist of a chorus of robots that can't carry a tune.

Parsing Improves Text-to-Speech Synthesis

Natural-language parsing is the ability to understand the underlying structure of a spoken language. It deals with the complex grammar of spoken (i.e., natural) languages, such as English and French, rather than the limited grammar of Pascal or C. Parsing is similar to diagraming sentences, as you used to do in school. With parsing, a text-to-speech synthesizer can operate on the sentence level rather than just word by word, leading to much more natural-sounding speech. (See "A Natural Solution," February BYTE.)

Words whose pronunciation changes according to their use can be handled only with a parser that "knows" how each word functions in a sentence. In the expression "Let's record that record-setting score," the stress is on the second syllable of the verb *record* but on the first syllable of the same word when it's used as a modifying noun. English has many words like this (e.g., *use*, *convict*, *invalid*).

The science of *prosody* deals with the pitch, amplitude, and duration of sounds in relation to one another. Because it varies according to the construction of a sentence, prosody provides cues that aid in understanding speech. The incorporation of prosody is less obvious, but more important, than simple stress in increasing the intelligibility of synthesized speech.

Almost all medium-priced to expensive synthesizers (e.g., Berkeley Speech Technologies' Bestspeech, Centigram Communications' CallText, or DEC's DECtalk) can raise inflection (i.e., stress) when a question mark appears. "Am I tired?" is pronounced very differently from "Am I tired!" They can also adjust pause length for commas, semicolons, and periods.

But without a parser like the one found in Emerson & Stern's Sound Bytes, it's impossible for synthesizers to adjust pause length at the end of unmarked phrases and clauses (e.g., "I would go...but I'm busy") or to change intonation when a noun is used as an adjective (e.g., "Green is my favorite color" versus "The green leaves turned yellow"). The glue words of English (e.g., articles and prepositions) are generally spoken quickly unless they are important ("I want that"). Without a parser, no way has yet been developed to determine importance. Human speakers provide all these prosodic cues unconsciously to help their listeners understand.

Natural-Language Parsing Trade-Offs

Computer parsers are not as capable as people at handling pronunciation that changes based on meaning or outside knowledge. In "I read well," the word *read* is pronounced as "red" when used in the past tense, but as "reed" when used in the present tense. The sentence alone cannot convey the writer's intention.

Parsers take up some memory and processing power, but not as much as some computationally intensive forms of synthesis. It's not parsing but the type of synthesis technology that drives the cost-versus-performance trade-off. Synthesizer prices range from $200 to $5000.

Bellcore's Orator synthesizer trades the ability to handle free text for the ability to handle names in a telephone directory, which often don't follow English phonetic rules. Some low-cost synthesizers have trouble with words such as *tough*, *through*, *though*, and *thought*, which don't follow English rules either.

What's Coming for Microcomputer Users

With more and more emphasis being placed on multimedia, you can expect PCs to have built-in sound-output capability like that already found in Mac and Next machines. The proliferation of machines and software will eventually lower the cost of high-quality synthesis, and system vendors will try to incorporate at least some parsing capability.

Get ready to buy some headphones or drive your officemates crazy. The talking computer is on the way!

Jan Zimmerman is CEO of Emerson & Stern Associates (San Diego, CA). She speaks and writes frequently on issues concerning speech and language. You can contact her on BIX c/o "editors" or on Applelink at D3881.

tion control, which is responsible for managing word and sentence pauses and pitch, and is mandatory for more believable pronunciation. This program segment bases its decisions on context and word placement. The bulk of inexpensive synthesizers don't use sophisticated intonation control, which results in a flat, monotone voice that is more difficult to understand. Many developers are focusing their attention on this module, because proper intonation is fundamental to more natural-sounding speech with less robotic tones.

Sound Bytes from Emerson & Stern Associates (San Diego, CA) is an example of speech software that is geared toward parsing for intonation and stress control. The software runs on the Mac platforms,

JIM POWELL
Texas Instruments,
Manager of Distributed Information Services

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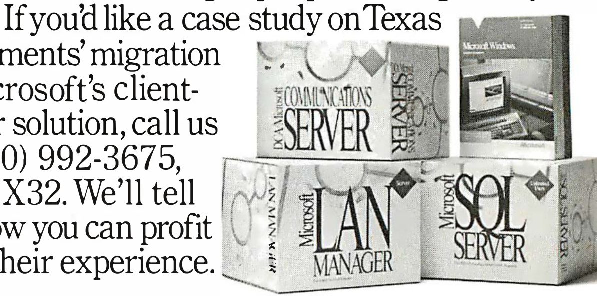
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Jim's group was able to quickly develop client-server applications, like the executive decision support system. Which means the users didn't have to wait forever to get the computer support they needed. And with Windows, the information on the mainframes was easier to access.

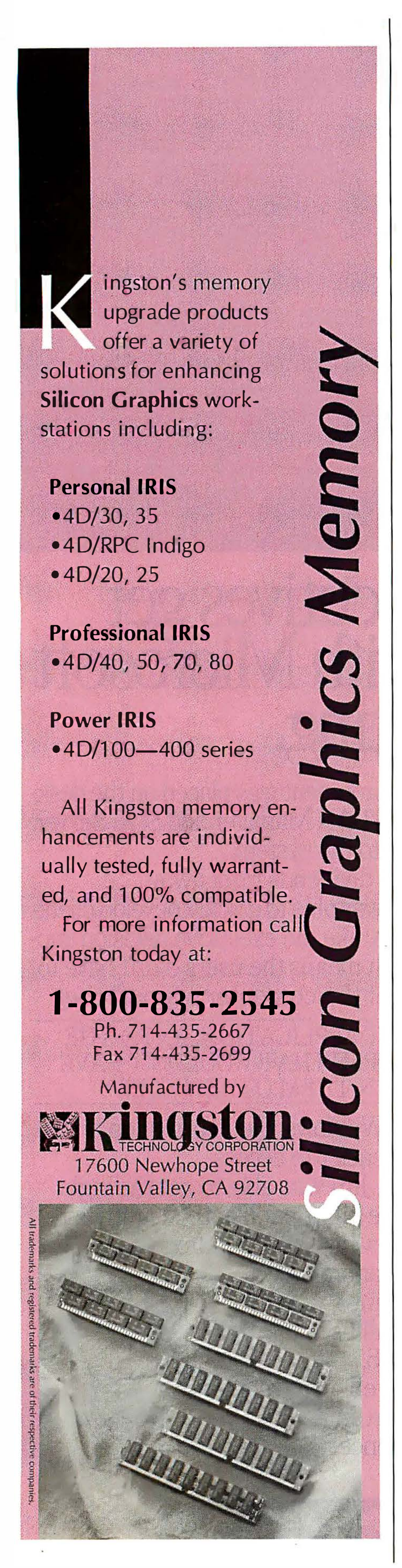
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and there are plans for it to run on the IBM PC in the near future. The text-to-speech software uses the Mac speaker and D/A converter. The company is now writing a speech toolbox for developers to create their own voice applications.

According to the company, Sound Bytes contains a parser that can determine a word's exact pronunciation from its context. The software can detect the difference between words that are spelled the same but pronounced differently, aiding pronunciation dramatically. The software also configures itself to avoid a monotone voice and automatically adjusts its rhythm to provide a more natural quality. The program is written entirely in C, which makes it portable from one platform to another.

We can look forward to higher-quality synthesizers over the next two to five years.

Sound Bytes' first step is to input ASCII text, which is fed into a 50-KB word-phonemic dictionary. The next step is to feed incoming text into a parsing system that sets parameters for rhythm and intonation. The following level involves feeding the output into a module that selects the proper diphones for the target text, and the result is sent to the D/A converter for verbalization.

Lernout & Hauspie (Woburn, MA) is working on an open-systems approach to software for text-to-speech synthesis, and it's collaborating with a number of companies in the U.S. and Europe, with the aim of providing multilingual speech software for a number of markets. The software supports American English, Spanish, German, French, Dutch, and Korean, and there are plans to add Italian and Japanese in the second quarter of this year.

Depending on the language, the software uses between 400 and 750 KB of memory. The code is written in C and is easily ported to a number of platforms, making it easier to develop specific applications for a number of markets. The software can be loaded into the RAM of a synthesizer board or box.

Lernout & Hauspie developed a reverse telephone directory using voice recognition and speech synthesis for the Belgian Post Telephone & Telegraph. The software uses heuristics to determine the proper pronunciation of names and addresses from multiple languages. The system is capable of determining the French, German, or Dutch pronunciation of a target phrase. The company also developed a telephone-based E-mail system using speech output for the South Korean government.

Berkeley Speech Systems (Berkeley, CA) is a leader in the speech-synthesis market, and it is offering speech technology to such players as Franklin Home Electronics for a line of portable information-retrieval systems. Berkeley is also keenly interested in the growing fax-to-speech market. First Byte (Santa Ana, CA), maker of the familiar Smooth Talker software, also markets speech software for MS-DOS and Windows. With all this in mind, I'll now look at some of the applications for speech output.

Automatic Mouths

Numerous productive applications take advantage of speech technology, and the list continues to grow. These include conversion of fax to speech, screen-reader software for persons with vision impairments, and telephone voicing of dynamic databases.

One of the most powerful applications of speech technology is reading fax messages with voice. Several cutting-edge companies are working on the problem, and Berkeley Speech Technology has obtained a patent for this money-making process. Fax-to-speech technology is a market that's almost certain to be a winner, because fax messages are so ubiquitous in today's business and industry.

The first step in fax-to-speech conversion is to translate the fax message to ASCII using optical-character-recognition technology. The typical one-page fax message can be converted to ASCII text using OCR in less than a minute. The Calera text-recognition board can convert a fax file stored on disk, or a flatbed scanner can scan paper-based faxes.

Once the fax is scanned into ASCII format, it's readable by a text-to-speech synthesizer. The text is sent to the speech synthesizer, which reads the message in any language that is chosen by the end user. The phone's Touch-Tone keypad is used to control the reading mode, and it can be used to start or stop reading at any time.

The Malibu Software Group (Malibu, CA) is developing a prototype OS/2-based

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system that's aimed at converting fax messages to voice in real time. It should be out by the time you read this, and it's anticipated that the system (including a dedicated workstation to house the fax server) will sell for about $15,000. It will allow a user to play back a fax message through a text-to-speech synthesizer with an unlimited vocabulary under the control of a phone's Touch-Tone keypad. The end user will be able to tie this system into a voice mailbox, and faxes can be played back through the speech board.

Vision-impaired people use talking computers to access text- and graphics-based systems. Sounding Board and the Vocal-Eyes screen reader from GW Micro (Fort Wayne, IN) form a state-of-the-art voice-access package that is capable of working with most DOS-based applications. The software and hardware can provide an unlimited vocabulary for most word processors, databases, spreadsheets, and other software. Outspoken from Berkeley Speech Systems is a GUI-oriented speech package for the Mac, and it's one of the most powerful graphics-based speech packages available to persons who have vision impairments. IBM is also developing Screen Reader/PM, a graphics-based screen-reader program for the visually impaired.

Answering machines were once the only device connected to most telephones. Now, thanks to text-to-speech synthesis, Touch-Tone keypads, and some newer devices linked to the phone line, reams of information can be as close as your fingertips. Speech synthesis is being combined with fax and telecommunications technology to offer a complete data-handling system with remote control.

Centigram Communications' voice-processing technologies are examples of telephone-based information systems. The company specializes in using voice output for transaction processing, data inquiry, text-to-speech applications, and visual output via fax and data. A caller can control a massive database containing technical documentation, listen to a series of voice menus, make selections using the Touch-Tone keypad, and have page after page of technical text and graphics faxed immediately to a distant location.

The Touch-Tone keypad and voice interaction with unlimited vocabulary can be used to trigger downloads from a remote location to a far-off office or job location. The system can also be used to trigger pagers to contact personnel that are in the field or on job calls. Speech-synthesis technology can be used to take the load off workers in an office, particularly when their time is spent delivering simple or repetitive information to clients (e.g., opening and closing times or address information).

A.B.C.D...

The future of speech synthesis is full of promise. The global market for this technology continues to expand as more foreign languages are added to the electronic vocabulary. There are few natural-sounding voice synthesizers on the market, however, with most synthesizers still clinging to their robotic tones.

We can look forward to higher-quality synthesizers over the next two to five years, with high-end products dropping in price as their technology is rendered less expensive by technical progress. We can also look forward to more equal opportunity among synthesizers, because the bulk of voice-output systems now use male voices. The future will offer greater opportunities to customize synthesizers, allowing the end user to choose the voice that is most pleasing for a particular application.

Multimedia will give a boost to the text-to-speech market this year, as it's applied to messaging systems, applications designed to aid the disabled, and database access over the phone. In 1993 and 1994, automobile-navigation systems will use speech to provide directions to drivers. These verbal-output systems will indicate when to turn and what routes to follow.

Speech support is being added to many platforms. Phoenix Technologies is incorporating support for Walt Disney's Sound Source digital-sampling system at the BIOS level, which will likely force other OEMs to jump on the voice bandwagon. In three to five years, voice synthesizers may appear in the form of single chips or dedicated chip sets that will allow integration of speech into everything from home appliances to workstations.

The growing applications of speech synthesis are driven by a basic force: Speech is simply one of the most powerful and natural forms of communication among humans. ■

ACKNOWLEDGMENT

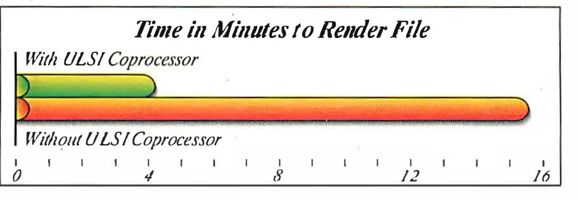
Special thanks to Tony Vitale of DEC.

Joseph J. Lazzaro is the cofounder of Talking Computer Systems (Cambridge, MA) and project director of the adaptive-technology program at the Massachusetts Commission for the Blind. He is a freelance writer and the author of a forthcoming book on assistive technology for disabled persons. You can contact him on BIX as "lazzaro" or on Internet as Lazzaro@world.std.com.

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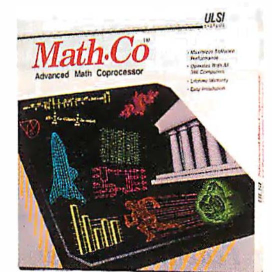


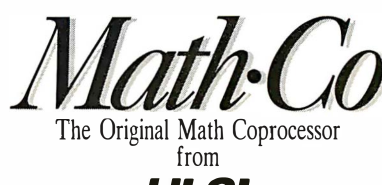
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THE ULTIMATE USER INTERFACE

Research from many fields is being synthesized to create a design philosophy for information environments

BOB JACOBSON

The physical and symbolic worlds in which we live and work are *information environments*. In them, we find the clues and cues we use to create the multidimensional mental maps and models that help us get around and do things in the real world. An encyclopedia, a TV broadcast, and a computer are IEs that produce virtual worlds with different qualities. The IEs addressed in this article are created by a computer, alone or as part of a network.

Successful IEs express a high degree of *virtuality*: a good fit between the external worlds they are intended to represent and the virtual worlds they actually produce. Today's hypermedia and virtual reality systems are the forerunners of tomorrow's highly virtualized IEs. With the best of today's systems, people will be able to work with information naturally, manipulate data comfortably, and share knowledge easily.

Tomorrow's highly virtualized IEs will be composed of synthesized sights, sounds, and tactile fields. Their sum will far exceed their parts, because future IEs will respond to more than an inhabitant's overt commands and requests: They'll respond to his or her mood and disposition as well. In tomorrow's IEs, people will work and play smarter and better, and they will have more fun. Over time, as richer IEs appear and more people experience better-designed virtual worlds, the information age will finally become participatory.

All these predictions will be realized, however, only if IEs are well designed. To create effective IEs, designers must shift their focus from the machines that generate IEs to the virtual worlds people experience.

continued

ILLUSTRATION: JAMES ENDICOTT © 1992

IE Design Is the Key

Good design is conscious and systematic, part art and part science. Its rules apply equally to the design of things, places, and processes. The best designs start by considering people, not things. For IEs, this practice yields a central rule for good design: Mirror an inhabitant's internal states to most effectively get information to and from the inhabitant (see the text box "What I Look for in an Information Environment" on page 178).

"The human body is admirably equipped for deeply interactive real-time communication via sounds, and even more admirably equipped to receive all sorts of information visually," says Jim Gasperini, author of the eerily real-world computer strategy game *Hidden Agenda*. "However, when it comes to sending visual information, the unmediated body fails. When it comes to storing information, the body quickly reaches limits set by memory and mortality. The Holy Grail of interactive design is to make it intuitive—meaning that the electronic-information environment so neatly mirrors the way people imagine themselves that it seems like a direct extension of their minds."

More than acting as a temporary extension of the mind, IEs will truly extend the mind by providing a strong component of learning as a continuous part of an ongoing, multisensory interaction. Meredith Bricken builds virtual-world models for the Human Interface Technology Laboratory (also known as the HIT Lab). She advises that "designing virtual-learning environments is substantially different from both traditional-interface design and traditional-curriculum design. Because the entire person is engaged in activity, designers must work on many levels" to build a multisensory, multimodal, personalized interface and curriculum. "The conceptual design of a virtual world defines what you do there, how you do it, what elements and behaviors you include [and exclude], and the context of the experience."

The ultimate goal in IE design is an understanding of the intended user.

The ultimate goal in IE design is an understanding of the intended user. IEs should fit the people for whom they're intended. Designers can customize IEs so that within them inhabitants can follow their own methods to navigate, perceive, identify, evaluate, choose, modify, and share information. To do these things, designers need parameters to guide them in their work in multidimensional realms. They have to find ways to guide users through the IEs.

Navigating in Information Space

Some methods designers employ to help users navigate IEs are derived from architectural theory. Architects, like IE designers, work in space, although the space they work in obviously has a physical component and is not wholly perceptual. They depend on an architectural discipline known as *wayfinding* (i.e., knowing how to get around), which is useful for designing IEs.

Wayfinding is behavior that may be embedded in our genes. The modern practice of wayfinding, discussed by Montreal architect Romedi Passini in his book *Wayfinding in Architecture* (Van Nostrand Reinhold, 1984) and by his Toronto-based colleague Arthur Frank in *Guidebooks for Public Works Canada* (Public Works Canada, 1984–1986), is a systematic method of designing comprehensible architectural space. Environmental cues located at key decision points help a wayfarer build a mental model and find a path to his or her destination. Similar cues can be designed in IEs.

A navigator sailing from island to island, an Australian aborigine on a walkabout in the outback, and an Inuit crossing an apparently featureless white landscape are navigating by environmental cues. The markers may not be directive; they may simply offer information that a well-educated wayfarer can use to plot a course, even in a dynamic environment. These cues may have meaning only in the context of their environment, however, so understanding how one's environment works is often crucial to finding one's way in it.

Syracuse University's Mike Nilan reinforces the need for deep knowledge: "The spatial characteristics of the IE must be structurally similar to the semantic dimensions used by the people who are trying to make sense of the problem, decision, or sought-after experience. At Syracuse, we are working on an IE for students. Its interface will be a three-dimensional map of the university that will enable students to go around the campus and get access to a variety of information and the campus computing facility."

When Navigation Doesn't Work

The navigation metaphor doesn't represent a universal solution. Psychologist Don Norman, author of *The Design of Everyday Things*, formerly titled *The Psychology of Everyday Things* (Basic Books, 1988), believes that navigation, in the sense of following a chart, "is unworkable once the size of the data set gets large." He foresees the incorporation in virtual interfaces of teleports: "I walk to the teleport and describe what I am interested in (by talking, typing, drawing, pointing, selecting—what have you), and then, whoosh, I am teleported to the place."

"The problem," says Alan Wexelblat, a virtual worlds theorist with Bull Worldwide Information Systems (Billerica, MA), "is that most information spaces have no natural order or arrangement. Architecture, CAD, and so forth—all have a natural order imposed by the 3-D geometries and laws of the physical world. But nothing like that works for the information space of all the artifacts generated in a software project (e.g., code, documentation, specifications, requests for change, requirements, and design rationale). The amount of data in such spaces is truly massive (millions to hundreds of millions of objects). Only by imposing some kind of order on it can designers possibly make it comprehensible. That is the central challenge of information-space design."

The massive complexity of information envisioned for many IEs may not be the problem it first appeared to be, because the information is in digital form. "In fact," remarks HIT Lab researcher Suzanne Weghorst, "the value of digital information is that it is mutable. You can transform it systematically or idiosyncratically, t rough

BYTE ACTION SUMMARY

Although the technologies for building virtual worlds are progressing rapidly, the design of the information environment that a virtual world represents will determine success. Designers are drawing on methods from a great many fields to guide their efforts to create effective IEs.

What I Look for in an Information Environment

In my meanderings around the information universe, there are few things more important to me than the quality of the virtual worlds that I build in my head, using cues from the worlds outside and what I already know. How well these mental maps and models take shape is directly attributable to the care with which various information environments (IEs) were designed.

Everyone has favorites among today's IEs (including virtual environments, The Well, Usenet, CompuServe, and even Prodigy). The best of these share characteristics that you may want to apply to future nonscreen-based IEs, such as virtual worlds:

coherence—The best IEs are clear. Their embedded meanings are, if not immediately evident, at least not cloaked. There is an internal logic to the relations within the IE and (if it aspires to represent the external world or some element of it) a reasonable correspondence between what is represented and what happens in the virtual world and what happens in the objective world.

inclusiveness—I like IEs that take me in. When I visit the Well, even though only my visual sense is stimulated (and then only by the characters on the CRT), I feel as if I'm in a living community made up of acquaintances and friends. In a state-of-the-art virtual world, my aural machinery is also used, and the visual stimuli are fast-changing pixels that, taken together, represent for me another place entirely, with its own rules and processes. I am there, inside.

malleability—A malleable IE is one that I can sculpt to fit my own instrumental needs and aesthetic tastes—a virtual world, for example, in which I can add sound to the color of the sky, reduce gravity, or realize (a step up from visualize) a complex financial process. A hypertext database that has been thoughtfully designed can be a thing of beauty if I can easily reconfigure my progression among the records to seek knowledge in my own idiosyncratic way.

engagement—The engaging IE takes me seriously and invites my complete participation in its processes. It's a place where little time is spent carrying out bureaucratic rituals (e.g., reprogramming an arcane operating system) and plenty of time is available for exploring what is the essence of the IE—the opportunity it offers the inhabitant. And I feel very disappointed if I am asked to leave the engaging IE prematurely, before I have experienced some epiphany.

authorship—Like a signature on a lithograph or the proprietor's estate on the label of a bottle of wine, the identity of the designers of memorable IEs is always evident. A good IE designer may leave just a vanishing trace of his or her identity before getting out of the way to allow an inhabitant to turn the world upside down, or the IE may be so stylistically strong that you meet the designer everywhere.

responsiveness—There is great pleasure to be found in IEs that acknowledge human difference and permit an inhabitant to customize the IE in his or her own image. A transaction with a bank automatic teller machine is not characterized by responsiveness. Responsiveness is exemplified by the designer of an IE who holds forth the rules by which the IE runs and then allows (or even exhorts) me to learn and change those rules. Well-designed IEs liberate their inhabitants.

purpose—There is nothing so priceless in today's time-starved world as a thing that does what it is intended to do—and does it well. Allow me to enter a virtual world that shows me what it's about, and I'm thrilled. If it's a place to poke about in and explore—a learning environment—have it say so loudly and directly. If it's where a task is to be done, have it so inform me, and let me at it. A design that dithers is unforgivable. Clarity of purpose is nirvana, in IEs as in life.

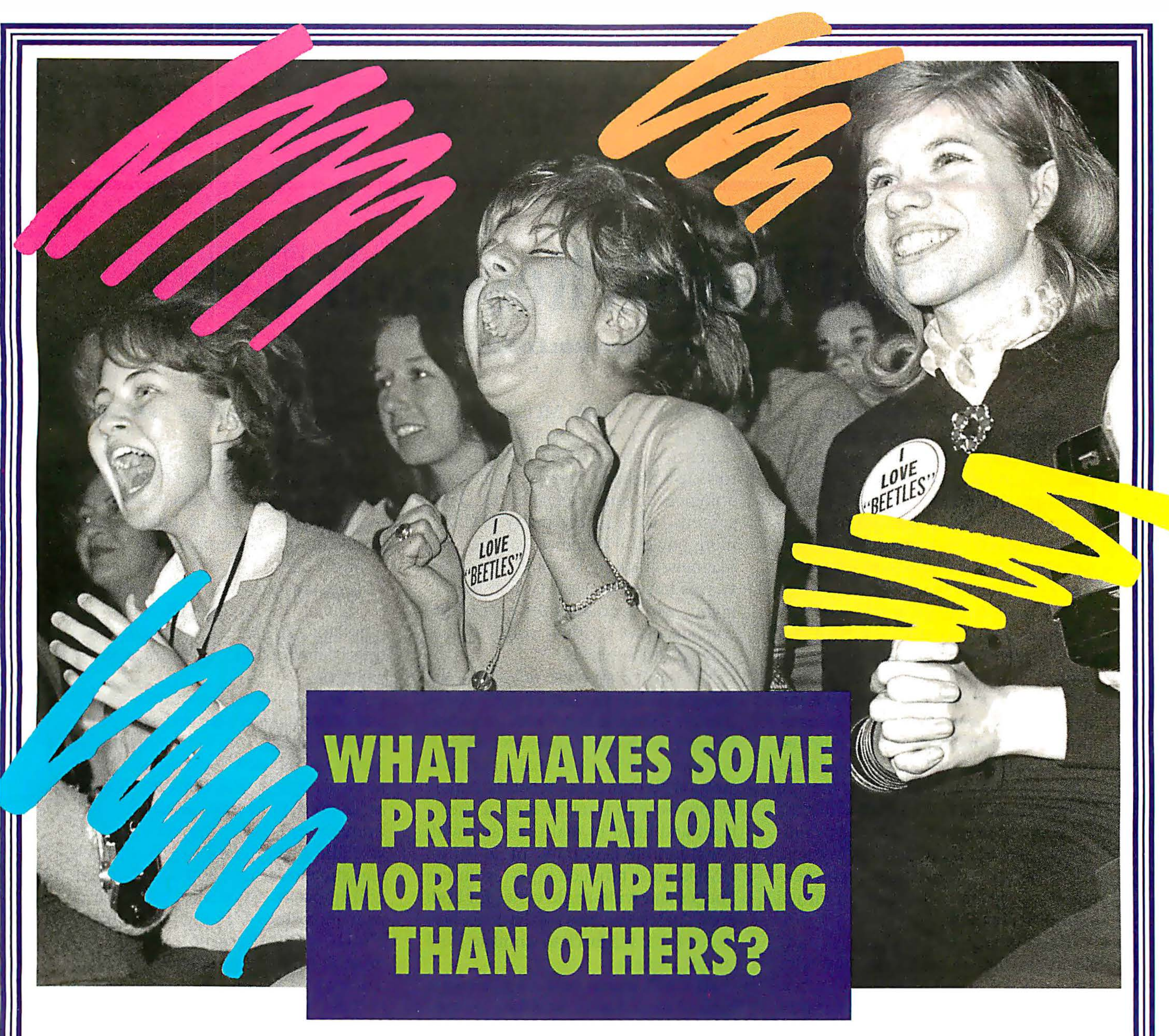
your own eyes or through the eyes of other people. Moving about in a collective world, the inhabitant can use the comparative experiences of other inhabitants as a filter: What does he see? What did she think was significant? The next step is IEs that incorporate this filtering mechanism so that copious information, far from being discouraging, becomes grist for the inhabitants' perceptual mills."

For Brenda Laurel, a principal in the IE research firm of Telepresence International (Los Gatos, CA), "the interface to a world of information can't be about representing information; it must be about *doing* things with information, from experiencing it to more subtle goals like identifying [its author's] point of view." Laurel identifies two crucial R&D targets: creating systems that can generate multiple representations of information that are responsive to an individual's sensory characteristics, preferences, skills, and needs; and providing contexts and materials in the interface for cognitive and emotional synthesis of information, not as post hoc analytical tools but as part of an individual's real-time process of constructing meaning.

Guides for IE Design

Just as designers borrowed architecture's concept of wayfinding, so they can borrow methods from many other fields (e.g., information-systems design, library science, and organizational theory) to design IEs that people can comfortably inhabit. *Sense-making*, an information-sciences design discipline, is one example.

In the mid-1970s, Ohio State University



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Virtual Worlds Research Today

RICHARD HOLLOWAY

Imagine you're walking through a house—a fire crackles in the brick fireplace, an ebony grand piano plays in the living room, and glasses clink around the wooden dining room table. The images you see and the sounds you hear are quite lifelike, yet you're not actually in this house at all. You're in a virtual world.

A system developed at the University of North Carolina at Chapel Hill that allows you to walk through scenes like those I've just described consists of a VPL EyePhone for displaying the images, an optoelectronic tracker for monitoring head position and orientation, and a massively parallel graphics engine for generating the images that are displayed on the head-mounted display (HMD). Although the latter two components are unique to the UNC system, the system I've described is representative of the state of the art in virtual worlds technology.

Even though this technology may seem new, much of the virtual worlds research was inspired by Ivan Sutherland's pioneering work in the 1960s. In 1965, he postulated that "the ultimate display would, of course, be a room within which the computer could control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal."

For years, research in virtual worlds technology was pursued by a relatively small core of organizations, among them Wright-Patterson Air Force Base (and other military labs and contractors), NASA-Ames, MIT, and UNC. Recently, however, the number of researchers working in this field has skyrocketed, probably because of the technological advances in small LCD TV screens (used inside many HMDs), more powerful graphics systems, and magnetic tracking systems. These advances have increased system performance and decreased the cost of the components of a virtual worlds system to an affordable level.

Yet despite all these advances, the major technical problems that existed in the late 1960s remain with us today. Image generation of complex scenes is still quite difficult at real-time rates (around 30 frames per second). It must be possible to track at least a user's head and hand in real time and with considerable accuracy. In addition, HMDs must produce high-resolution images and wide-angle views for both eyes. And researchers still have not perfected force feedback to simulate even simple objects.

At UNC, researchers are addressing each of these issues, and they are carrying out projects for using this technology in real-world applications. Research is taking place on the visualization of protein structures, architectural building walk-throughs, radiation-treatment planning, and medical x-ray vision.

Some of the UNC system's capabilities illustrate what is possible today. In terms of image generation, the system's graphics engine (called Pixel-Planes 5) can draw more than 2 million Phong-shaded z-buffered triangles per second. The ceiling system can track a user over a 10- by 12-foot area at an average rate of 50 to 70 updates per second. The VPL EyePhone Model 2 HMD has a horizontal field of view of 80 degrees per eye and a resolution of approximately 210 by 140 full-color pixels (the newer Eyephone HRX model has roughly twice this resolution). The system provides force feedback for a user. Its Argonne Remote Manipulator can give a user feedback via three forces and three torques at the handgrip.

Current systems are often too slow and cartoonlike for a user to truly suspend disbelief. Yet each year, faster hardware and new technologies bring us closer to a system that can let users believably experience another world. In the future, faster graphics systems will allow for more complicated and realistic virtual worlds. Faster trackers will improve a system's response to user movement. Higher-resolution HMDs will display more compelling images. And force feedback will allow a user to "reach out and touch" virtual objects. Virtual worlds such as those produced by flight simulators are already convincing enough to be useful. In time, there should be virtual worlds systems that are good enough for real work in other fields (e.g., medicine and scientific visualization).

Richard Holloway is a student at UNC at Chapel Hill who works on the HMD project. His Ph.D. project is on x-ray vision for craniofacial surgery planning. You can reach him on BIX c/o "editors" or on Internet as Holloway .cs.unc.edu.

professor and communications theorist Brenda Dervin began asking her subjects the following questions: What are the problems most important to you right now? What obstacles block your way? What assistance is available to you to solve those problems? Tens of thousands of questionnaires and interviews later, Dervin and her team of researchers discovered why, in particular situations (e.g., a person trying to get across town, a welfare mother dealing with a faceless bureaucracy, or a student looking for a citation), some people can accomplish their goals while others remain helpless and frustrated.

Making sense depends on two important ingredients: the accessibility to the person in the predicament of comprehensible information, and the ability of people to conceptualize and cognitively bridge gaps in their understanding. "If you look from the inside (i.e., as the person sees the world), you find there are many ways to attain goals. The variety can be bewildering." One method of IE design is to limit goal paths to those most desirable to an inhabitant. Another is to train a person to

choose goal paths more wisely. A third is to propose new goals. Each method has its adherents among designers.

Sense-making's investigative methodology is also a reliable research tool that produces dependable qualitative and quantitative results. These results indicate what and how information works in a defined setting. With this tool, designers can refine IE prototypes and ensure that they accomplish the inhabitants' purpose.

From library science, designers can borrow methods found in guidebooks that spell out, in the simplest terms, how to help library patrons identify, find, and act on useful information. Organizational analysis offers some guidance for the design of multiple-inhabitant IEs, which will become increasingly common as technology develops.

Tomorrow's IEs that are built on data networks will be variegated. Many may be consensual (i.e., defined by their users). Users will enter the networked IE from many locations and situations, likely with different motives and personalities. Should we make it easy for inhabitants to hide their personalities and intentions, or should we encourage candor and direct communication? For some situations (e.g., the workplace), the networked IE will be deemed most successful when all participants share the same perceptions and meanings.

How will an appropriate group environment be designed? An understanding of group dynamics and mediated communications will help, although it may not provide all the answers. A designer may have to rely on anecdotes and metaphors for a fuller understanding of a multiple-inhabitant IE and how best to design it.

Finally, usability research is valuable for IE design. Such research can also bridge the potential gap that might otherwise separate the design of IEs from the design of their supporting platforms. Usability research, properly used, can determine the capacity of a specific system to support a desired IE. In a virtual classroom, for example, designers want an IE to be driven by a computer system that can generate a seamless visual and aural (and eventually tactile) presentation while being responsive to rapid inputs from diverse participants. The IE must provide its inhabitants with a high degree of interactivity and malleability. Usability research makes it possible to test these properties using both qualitative and quantitative indicators.

Involving the User in Design

Users should be involved in the design of IEs. "I guess I like the term *participatory design*," says Michael Good, director of DEC's Presence project, which conducts virtual worlds research. In DEC's software usability engineering group, according to Good, users define usability, work influences user experience, and collaboration in the design process melds users and designers into a team.

The design of multiuser IEs is ultimately more complex than simply defining an environment for group interaction. Advises Charles Grantham, group-work consultant and member of the Association for Software Design, "Data becomes information when it is placed in a social context. Information technologies are coevolving with human organizations. Designing information environments for work today is really engaging in wholesale community reconstruction." Or as Marshall McLuhan so presciently said more than 25 years ago, "The medium is the message." If so, IEs should be well-designed, for their very form and construction inherently convey the worldview—the meta-message—of their designers better than the artifacts they overtly contain.

"Designing IEs for work today is really engaging in wholesale community reconstruction."

Eventually, IE design will mature from an idiosyncratic art to a craft and, perhaps, an industry. Well-designed IEs will make it easier for more people to use computers, both for traditional purposes and in new ways.

Rapidly changing technology capable of supporting highly developed IEs will spur this evolution (see the text box "Virtual Worlds Research Today" on page 180). IE design will subsume (not replace) on-screen 2-D visual graphics. Graphical interfaces, multimedia, and hypermedia (including virtual interfaces and databases) will continue to develop and eventually merge into tomorrow's IEs.

But will the new media of telecommunications—especially high-speed broadband networks—deny designers ultimate control of their IEs, as technocontrarian Tom Hargadon contends? Hargadon, publisher of the multimedia newsletter *The Green Sheet*, predicts "users will complete their worlds for themselves, in whatever media they choose. [Designers and vendors] will be transmitting useful but clearly incomplete products; value will be added at many places. We are moving toward pervasiveness and completion at the end, not the beginning!" The best IEs, like the best places to live, work, and play, will be capable of being customized.

As IE platforms increase in number, decrease in size, and become less expensive, inhabitants will be able to build in multiple dimensions of sight, sound, and tactility. They will routinely generate and refine personal and collective IEs. In time, perhaps many people will fancy themselves IE designers. It's wise to remember, however, the plague of poorly designed documents that resulted from widespread desktop publishing. Although well-designed IEs will make more of us good designers, as Steve Feiner proposed, the best designers will always remain members of a select guild. It will be their responsibility to train talented aspirants so that IE design develops from an art to a craft. Will IE design finally become an industry, as has software design before it? In that case, something very dear might be lost: the designer's sensitivity to what is right.

Janey Fritsche, who codesigned the Guides project for the Apple Media Lab, implores future IE designers to know empathy: "The success of a design depends on sensory reaction, as opposed to analytical stimulation. It behooves designers to exercise artistic sensibilities that are well honed. Most of the impact of interactive multimedia and virtual reality is a 'feeling' thing. It helps to approach each project as a work of art. Just as each piece of stone speaks to the sculptor, each project speaks to the designer. Listen with the heart and be guided." ■

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Bob Jacobson is president of Worldesign, a company that designs televirtual worlds for industrial applications. He is a research professor of landscape architecture at the University of Washington. You can contact him on BIX c/o "editors" or, as the moderator of the Usenet newsgroup sci.virtual-worlds, on Internet as @well .sf.ca.us.



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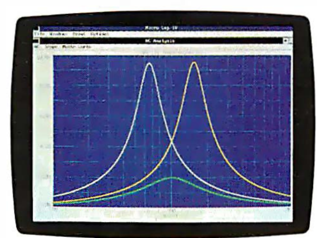
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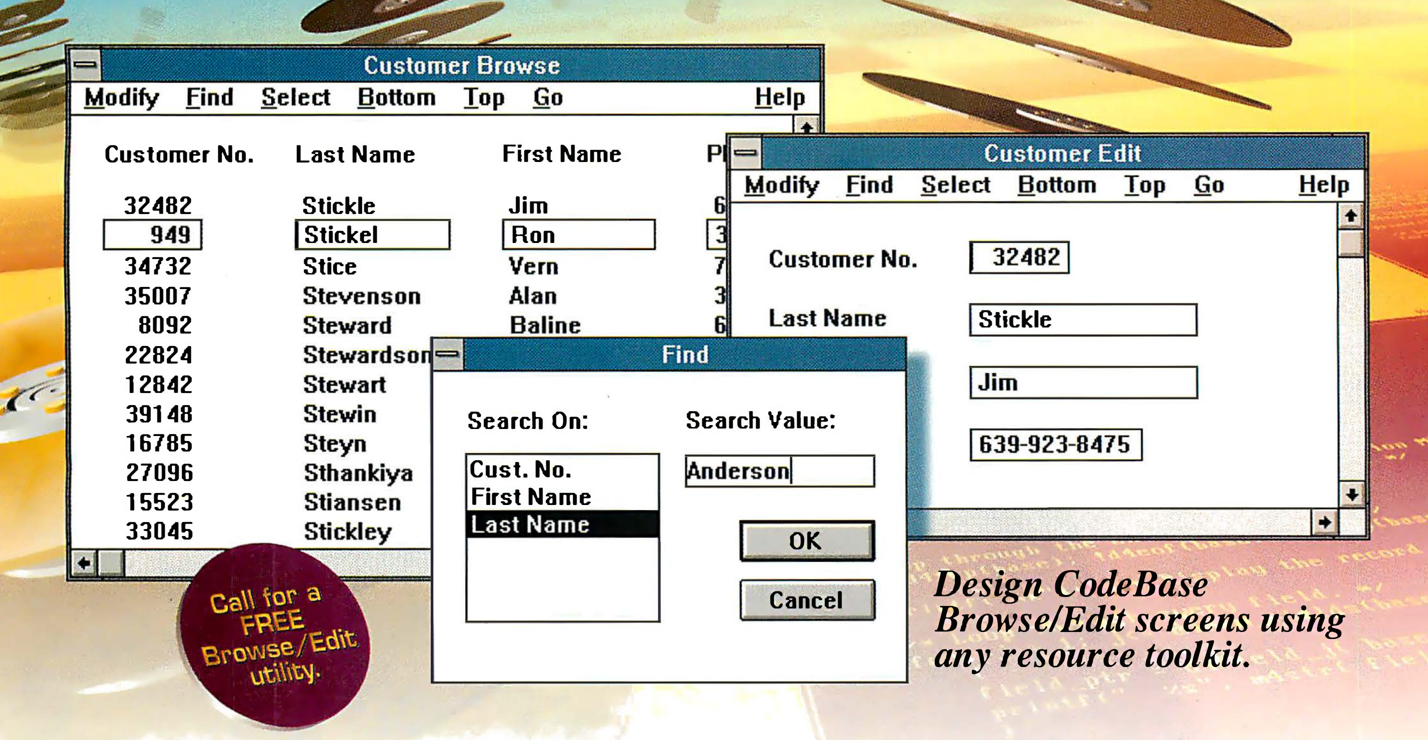
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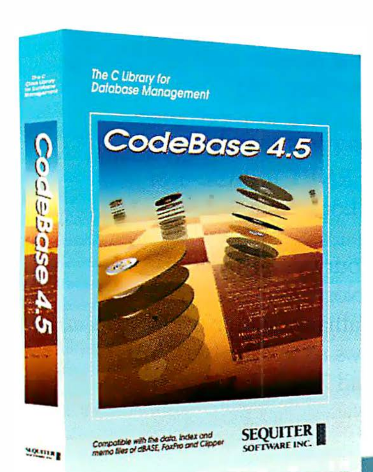
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NEW LAN BACKUP TOOLS



The BYTE Lab looks at eight LAN tape backup packages that promise to keep your files safe

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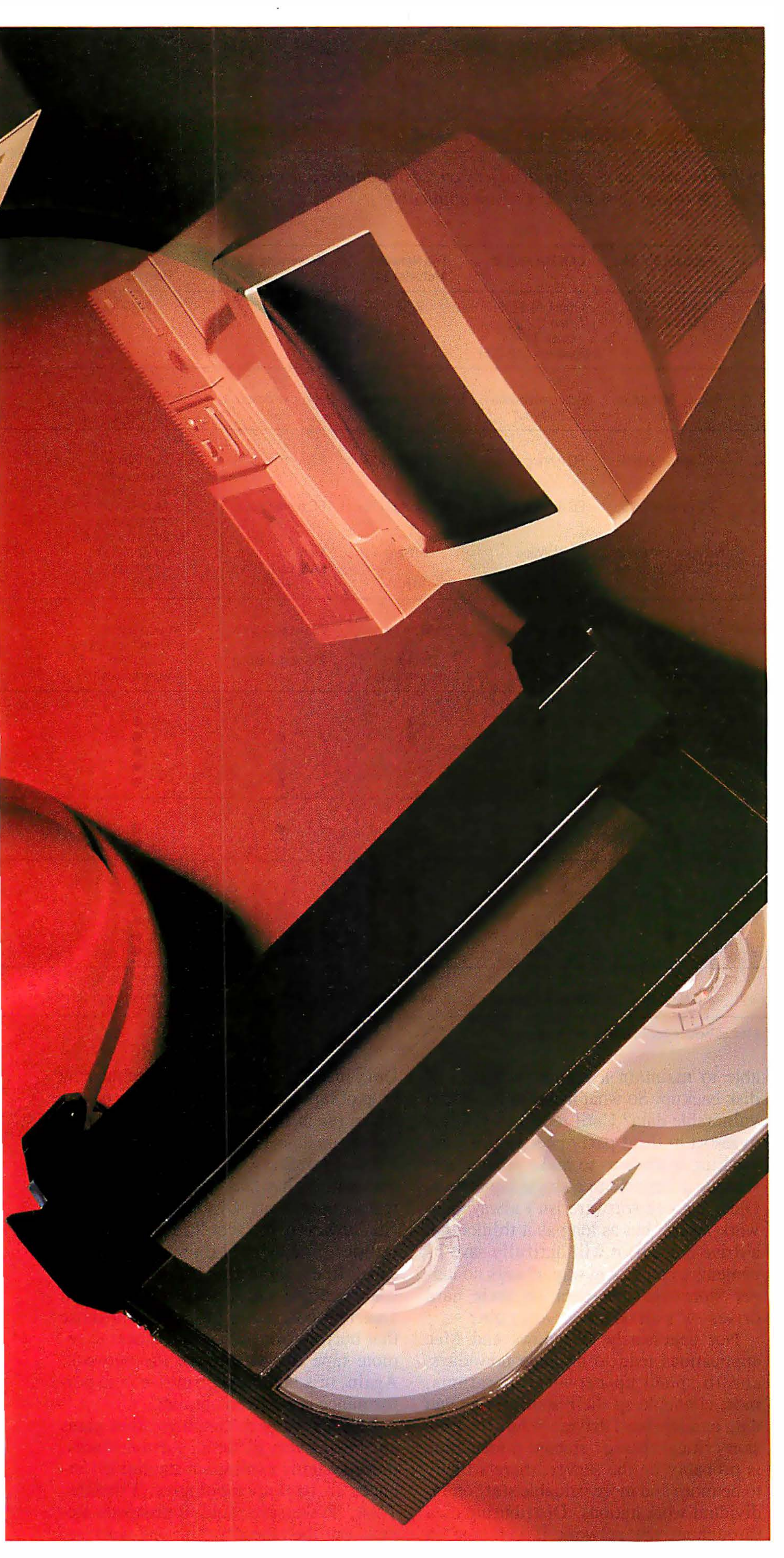
Flash! Lightning strikes a power pole near your building just as you are updating the company database. The power blinks out for a second, and the file server and some of your workstations crash. You reboot the systems, only to find your database wiped out. The immediate order of business is to repair your damaged data. First thing tomorrow, you'll investigate centralized tape backup systems for your network.

Reach Out and Touch Some Ones (and Zeros)

As we rely more and more on LANs for storing mission-critical applications and data, we've begun to take for granted that our data will always be secure, organized, and readily accessible. But backing up and managing data for an entire network is a daunting task that involves more than copying a network's worth of files onto a tape drive. Fortunately, a new generation of sophisticated LAN tape backup software promises to solve the complex problems of networkwide data backup and archiving, tape rotation, and disaster recovery. For network clients and administrators, this can mean that important data is safe even when mistakes and malfunctions threaten catastrophe.

In this Solutions Focus, the BYTE Lab evaluates eight DOS, Unix, and Mac products that treat your entire network as a collection of data to be safeguarded. Cheyenne Software's ARCserve supports workstations running DOS, Windows, or OS/2, as well as NetWare file servers. Four products—Maynard Electronics' LANStream, Mountain Network Solutions' FileSafe, Palindrome's The Network Archivist (TNA), and Performance Technology's Powersave—handle DOS workstations and file servers. Delta Microsystems' BudTool and Legato Systems' Legato NetWorker give your Unix network shared access to a single tape drive. Dantz Development's Retrospect Remote lets a single Macintosh back up both Mac file servers and clients' Macs. (See the table for a complete rundown of the features offered by these packages.)

All these products address both servers and workstations in their backup



BYTE ACTION SUMMARY

WHAT LAN TAPE BACKUP SOFTWARE DOES
With a shared high-capacity tape drive on your LAN, all clients on your office network can safely store their important files on tape.

LIKES
A shared tape drive makes it easy for system administrators to back up clients' workstations in a cost-effective manner.

DISLIKES
Setting up a LAN tape backup system can be complex at best and very aggravating to debug. Many administrators will want to call in a consultant.

RECOMMENDATIONS
The Network Archivist does a remarkable job of automating NetWare backups; ARCserve and LANStream are good alternatives. Legato NetWorker is our choice for powerful yet easy-to-use Unix network backups. Retrospect Remote is an excellent Macintosh backup package.

schemes. We chose systems capable of sorting 1 gigabyte or more of data, a threshold for performing an unattended backup of an entire network (for a discussion of tape drives with more than 1 gigabyte of storage, see the text box "Life Above 1 Gigabyte: DAT vs. 8-mm vs. QIC" on page 197). Our test sample consisted of stand-alone software and software/hardware bundles. In some cases, drive vendors repackage third-party software with only minor alterations. We didn't test the variations, but let the original software represent the group.

Network Concerns

Besides safeguarding data with regular backup schemes, these products attempt to solve problems vital to networks. For example, you should devise a workable tape-rotation scheme so that the loss of a single tape is not a catastrophe. Backup software with integrated schedulers can help. Software can also perform incremental backups, copying only the files that have changed since the last backup. A good rotation scheme will include a regular schedule of full and incremental backups. In one instance, the software can fully automate the rotation process.

What if you need an earlier version of a particular file? A documented catalog of your tapes, together with ample notes,

LAN BACKUP SOFTWARE

The new generation of LAN tape backup software takes some of the drudgery out of administrative chores such as scheduling, file migration, and tape rotation. (● = yes; ○ = no; N/A = not applicable.)

	DOS					MAC
	ARCserve 4.0	**FileSafe 5.2.2A**	**LANStream 1.0**	**The Network Archivist 2.0**	**Powersave 2.2**	**Retrospect Remote 1.3**
Price	$295 to $1895	FileSafe: $495 FileTalk: $495	4-mm DAT:$7495 8-mm, 2.2 gigabytes: $8995 5 gigabytes: $10,795[1]	$995	$1995	$449
Architecture						
Topology	Tape server	Backup workstation	Backup workstation	Backup workstation	Backup workstation	Backup workstation
Push/pull	Push/pull	Pull	Push/pull	Pull	Pull	Pull
System requirements						
Workstations	PC running DOS, OS/2, or Windows	PC running DOS	PC running DOS	PC running DOS	PC running DOS	Mac Plus or better running System 6.0.x or 7.0
Tape server	PC running DOS	PC running DOS	PC running DOS	PC running DOS	PC running DOS	Mac Plus or better running System 6.0.x or 7.0
Network	NetWare	NetWare, LANtastic, PC-LAN, 3+Share	NetWare	NetWare	NetWare, Vines, LANtastic, 10net	Any AppleTalk protocol
User workstation TSR/INIT RAM	18 KB	35 KB	45 KB	10 KB	N/A	97 KB
Protected workstations						
Basic package	Unlimited workstations	3 workstations	5 workstations	350 MB on network	255 workstations	11 workstations/ unlimited servers
Maximum protection	Unlimited workstations	Unlimited workstations	Unlimited workstations	Unlimited network data	255 workstations	Unlimited workstations
Devices supported						
4-/8-mm	●	●	●	●	●	●
Cartridge tape	●	●	○	●	●	●
Floppy disk	○	○	○	○	○	●
Removable hard drive	●	○	○	○	○	●
Multiple devices	●	●	●	○	●	●
Security						
Workstation access password?	●	●	●	○	●	●
Workstations must be logged in?	○	○	●	○	○	●
File management						
Automatic file migration	●	○	●	●	○	○
Phantom files	○	○	○	●	○	○
Back up to other drives?	●	○	○	○	○	●
Macintosh naming support	●	●	●	●	○	●
File histories	●	○	●	●	○	●
Tape rotation						
Method	Grandfather-father-son	Manual	Prompt for blank tape	Tower of Hanoi	Manual	Manual

[1] Prices include software and hardware.

[2] Prices include device drivers but no hardware.

will enable you to restore older versions of important files. Alternatively, backup software can keep track of file histories for you, listing the version dates and prompting for the correct tape when a specific version is restored.

A good backup strategy will also address the thorny problem of disk space on the server. Unused files should be shuffled off to tape and removed from the server altogether. In some cases, a zero-length file will remain on-line so that if the file is called, the backup software will restore the original file from tape and deliver it to the application. The trend is toward tiered storage, where files migrate first to a large-volume on-line storage medium such as read/write optical before being archived to tape.

And what about the workstations on your network? More often than not, local stations will not have the resources available to maintain a regular schedule of disk backup. So what happens to all that vulnerable data? Until recently, you had to resort to third-party peer-to-peer networking extensions to make other workstations accessible to a single tape drive. Older backup software isn't always network-aware, but as long as it thinks that a drive is local, it will dutifully save its contents to tape. Anyway, clients no longer store valuable data on their hard drives—it's all on the server, right?

Not necessarily. Windows and Mac applications tend to be huge nowadays, and to speed up network operations, most clients keep their applications and data on local hard drives. While the mission-critical shared database information is probably on the server, there's likely to be more and more valuable stuff on individual workstations. Distributing data throughout the network is common in Unix installations. That's where the new crop of tape backup software comes in—it can reach through the wires and grab data from anywhere for safekeeping.

Most versions of Unix include a set of commands that handle file backup and restore operations. Despite the cost benefits, however, the standard Unix backup utilities provide only the most primitive capabilities; some even lack the ability to span multiple tapes. Berkeley Standard Distribution flavors of Unix, and those that borrow from BSD, add access to remote tape drives through the network. Again, this facility is primitive, and performance is far from optimal.

Besides using different rotation plans and having very different user interfaces, these systems exhibit substantial differences in backup topologies. FileSafe, TNA, Powersave, and Retrospect Remote put the tape drive on one worksta-

UNIX	
BudTool 4.0	Legato NetWorker 3.0
Prices range from $4995 (for single tape drive support) to $29,995 (for a large jukebox)²	$2000
Tape server	Tape server
Push/pull	Push/pull
Unix	Unix, DOS (with PC-NFS)
Unix	Unix
TCP/IP	TCP/IP
N/A	N/A
One server, unlimited nodes	5 workstations
Unlimited workstations	200 workstations
●	●
●	●
○	●
●	●
●	●
Through Unix	Through Unix
●	●
○	N/A
●	N/A
●	●
N/A	●
●	●
Manual	Tape expiration dates

tion—most likely the system administrator's. That workstation runs a standalone application that accesses the file servers and other workstations (see part a of the figure). LANStream requires you to designate a workstation as a dedicated backup server. ARCserve treats the tape drive as a shared resource (see part b of the figure) and puts the drive on one of the system's NetWare servers. The administrator grants access to a backup queue, and clients post requests to the server. BudTool and Legato NetWorker use Unix's multitasking capabilities to turn one of the networked workstations into a nondedicated tape server.

Test-Beds

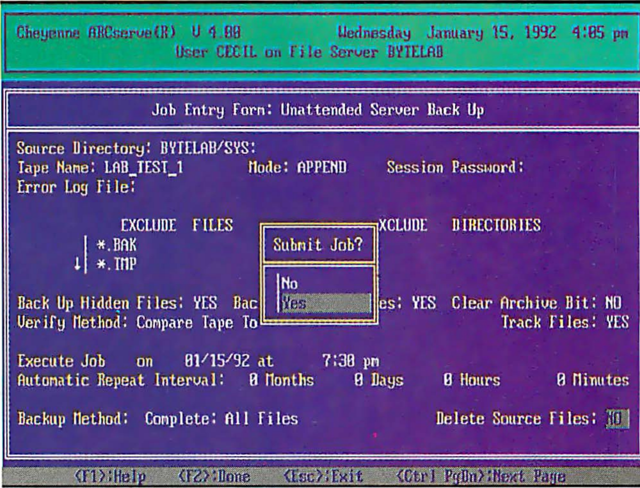
We installed each package on one of three test-beds. Our NetWare test-bed consisted of a 486/33 file server running NetWare 3.11, Dell and Tangent 386/25 workstations, and an assortment of 4- and 8-mm helical-scan tape drives. Some drives came with their own proprietary SCSI controllers and drivers; others supported an Adaptec 1522 SCSI controller.

We tested the two Unix packages on an isolated network that included an Opus System 5000 SPARC workstation, an Altos System 5000 486/33 file server, and several DOS systems. We set up the Opus as the backup server using its 150-MB internal quarter-inch cartridge (QIC) tape drive as the backup device.

Retrospect Remote ran on our Macintosh AppleShare network with a mixture of AppleShare and NetWare for Macintosh AFP-compliant servers. As workstations, we used a Mac IIfx connected to an Irwin 5080 cartridge tape drive, an Archive Python 2-gigabyte digital audiotape (DAT) drive, and an Iomega Bernoulli 90 removable cartridge drive. The clients were a Mac IIci and a Quadra 900 running System 7.0, and a Mac II with a Radius Rocket running System 6.0.5.

Testing software designed to recover from catastrophic events is a complex task. We had to simulate weeks of normal use and then create a disaster. For each package, we formatted a set of tapes and backed up the network repeatedly to test the rotation and tape overflow features. To get a feel for recovery mechanisms, we occasionally deleted directories and restored them from tape. When a package used the network storage for its own database (rather than storing it on tape), we damaged the database to see how well the software handled it.

Given so many different architectures and tape drives, we could not make objective performance comparisons. Performance on your network will depend on the particular tape drive, the network transport layer, and the I/O performance of your tape drive and interface.



Screen 1: *NetWare administrators should feel right at home with ARCserve's user interface. The Insert key brings up pick-list items, and you manage the backup job queues just like any other NetWare queues.*

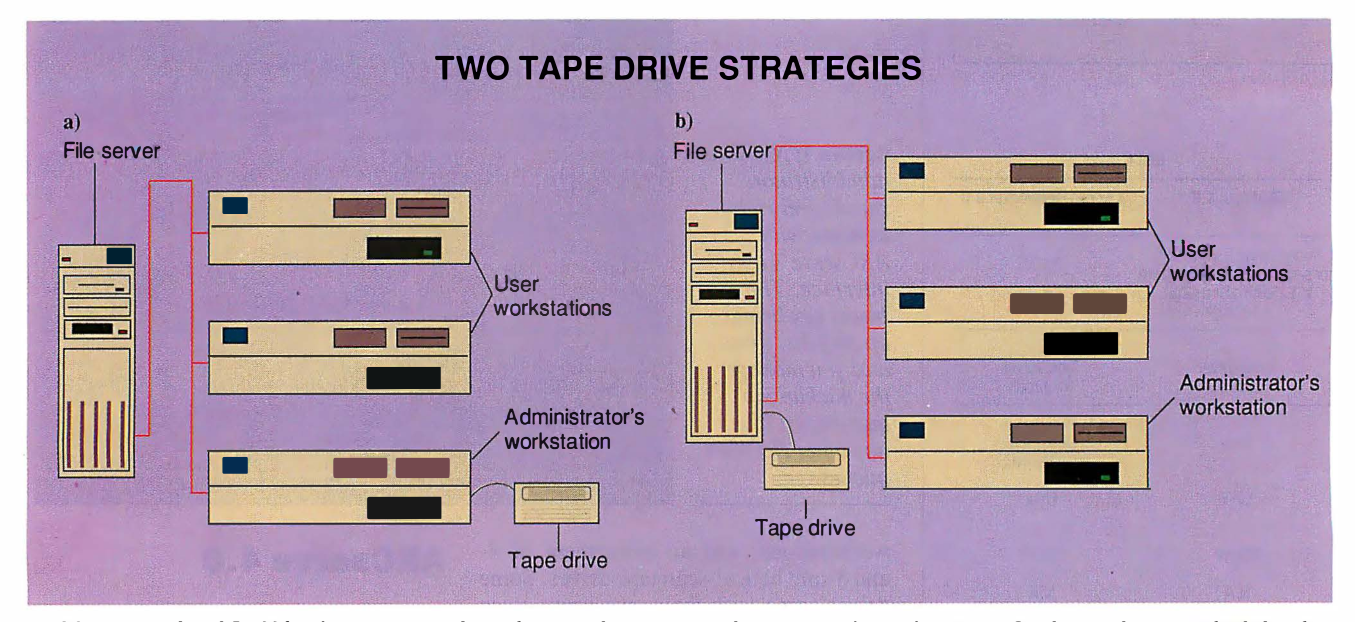
ARCserve 4.0



Of the DOS packages, Cheyenne Software's ARCserve had our favorite topology: The tape drive attaches to the file server, and the system administrator establishes backup queues much like NetWare print queues. Any client with access rights can then post a backup request to the server.

ARCserve looks exactly like any other NetWare utility (see screen 1). To place a backup job in the server queue, you select a queue from a pick list and press the Insert key. A window then pops up displaying the Unattended Operations menu. You select a function and choose a predefined script or make up a new one. The job will execute at the time you specify, whether you're logged in or not. The server knows enough to prompt you for a particular tape if you've specified one by name. You make your workstation accessible by running one of three TSR programs: DOSAGENT publishes your workstation by node address and makes your files available over the Novell IPX/SPX transport layer; WINAGENT does the same for workstations running Windows; and OS2AGENT is a background process for OS/2.

ARCserve uses a grandfather-father-son tape rotation scheme. This is perhaps the most common method for desktop computers and one that works well if you're diligent about keeping track of which tapes are which. Basically, you start with a full-system backup on a given day of the week. For the rest of the week, you perform incremental backups (i.e., backing up only new or changed files), preferably on a new tape each day. On full-backup day next week, you use a fresh tape to do another full backup. The full backup from the previous week



(a) *Most centralized LAN backup systems place the tape drive on an administrator's workstation. On demand or on schedule, the backup software reaches out through the network and grabs files from the servers and other workstations. Workstations have to "publish" their local drives to make them look like file servers.*
(b) *A shared tape drive is a resource, just as a printer or a high-speed modem can be. In some installations, putting the tape drive on the file server makes sense. Unlike an administrator's workstation, the file server rarely gets turned off, making it ideal for backup service. Another benefit is that, to back up the server data, the files don't have to be shuffled over the network.*

becomes an archive tape or is put into a 4- to 6-week rotation, depending on your needs.

At any given time, you can bring the system to a known state by restoring the last full backup and all the incrementals. ARCserve automatically handles the rotation by giving each day's tape a different name and making the right kind of backup (i.e., either full or incremental). It's still your responsibility to manage the sets of tapes.

ARCServe for NetWare 3.11 installs as a NetWare loadable module. You simply log into the server as SUPERVISOR, run a simple installation package, and then load the NLM from the server console. You specify ARCserve queues with a given user list and priority. Tape operations can be either attended or unattended. Attended backups happen on-screen while you wait. If the tape driver is busy, you get a message on-screen, and you're asked to try again later. Unattended backups go into a backup queue and get processed later at a time you specify.

We tested ARCserve with two Python 2-gigabyte 4-mm DAT drives connected to a single Adaptec controller. ARCserve queues aren't specific to a given drive; selecting the right drive on the SCSI bus is left to the ARCserve SCSI driver, which scans the tape labels looking for a match. If it can't find one, you get a NetWare message at the bottom of your screen asking for a new tape. We had no difficulty getting ARCserve running after we updated the IPX shell to the latest version (3.10), but the constant stream of NetWare SEND messages got to be a bit annoying.

FileSafe 5.2.2A



Mountain Network Solutions' FileSafe provides two distinct user interfaces. A menued interface packs all the major functions of the software into an easy-to-use shell. Command-line utilities give you the same power through customized batch files.

The menued interface follows a hierarchical structure. The first screen presents the basic operations: backing up, restoring, and verifying. When you choose an option, such as Backup, from the main menu screen, a second screen appears with a menu offering the choice of Full, Selective, or Automatic backup. Should you choose to do a selective backup or restore, you are then presented with a list of drives, directories, and files to pick from. You can then tag the files you want to operate on. At this point, you can call an Include or Exclude box and use DOS wild cards to select or filter out specific sets of files. You can also restrict the backup to a specified range of dates, or you can back up only files created or modified since your last tape backup.

The Automatic menu option lets you schedule recurring jobs. You select the days of the week when you want the backup to run, the time to run the job, and the interval between jobs. You can then run a job every week on the specified day or at any set interval (e.g., every 2 hours).

According to Mountain Network Solutions, the tape drive has Quick File Access capability. QFA uses block addresses to locate data instead of sequentially reading through files. This feature did not appear to be operational in our setup. The drive seemed to read through the tape, trying to locate the files. At one point, the software took forever to display the directory structure of a selected drive. With the directory on-screen, we called for a backup but forgot to designate specific files. The software told us that no files had been selected. FileSafe had to search through the tape again to redisplay the directory.

FileSafe includes a full set of programs invoked from the DOS prompt. It also has a TSR scheduler that will fire off any command at an appointed time. If your system is busy at the appointed time, you can tell the scheduler to wait until the system is idle, or you can have the scheduler preempt a running program. We found the scheduler to be a bit

Life Above 1 Gigabyte: DAT vs. 8-mm vs. QIC

Roger C. Alford

Three primary tape-drive technologies are available that can accommodate the high-capacity storage requirements of modern LANs: digital audiotape (DAT), 8-mm tape, and quarter-inch cartridge (QIC). These alternatives offer trade-offs in capacity, speed, size, backward compatibility, and price, so you must choose the right platform based on your specific requirements.



Basic Technologies

Long popular for lower-capacity backup, QIC drives have recently reached into the 1-gigabyte-plus capacities. The QIC-1000 drives introduced last year support 1 gigabyte of data storage on a single DC6000 cartridge, and the newer QIC-1350 drives appearing this year tout a 1.35-gigabyte capacity.

DAT has been establishing itself for data backup since its introduction to the audio market in 1986. The DAT drive market has standardized on two incompatible data formats: DDS (digital data storage) and Data/DAT. DDS has achieved the greatest industry acceptance, and it is used by most current DAT drives. Data/DAT is somewhat slower than DDS but allows block and sector updating and high-speed file searches.

There are now numerous DAT drive manufacturers, including many of the established QIC drive producers. DAT drives offer 1.3 gigabytes of storage on a standard 60-meter data cartridge, and 2 gigabytes on the longer 90-meter cartridge. DAT cartridges use a 4-mm-wide metal-particle medium, and, at under ½-inch thick and smaller than a business card, the package is the smallest of the high-capacity data cartridges.

Eight-millimeter drives, introduced by Exabyte in 1987, are based on VCR technology. Exabyte remains the sole manufacturer of these drives, although many companies private-label the Exabyte drive. These drives use a data cartridge about the size of a deck of cards, incorporating an 8-mm-wide metal-particle medium. The 8-mm drives are available in 2.5- and 5.0-gigabyte capacities. The ISO recently voted to standardize Exabyte's 8-mm tape format.

Drive Comparisons

All the drives incorporate read-after-write data verification to ensure data integrity and use embedded error-correction codes to recover data if any data becomes corrupted. Most implementations of these high-capacity tape drives use the popular SCSI connection. While DAT drives are commonly available in a 3½-inch half-height form factor, QIC-1000/-1350 drives generally maintain a 5¼-inch half-height profile. The 8-mm drives have been traditionally packaged in a 5¼-inch full-height form factor, although newer half-height models are now available.

QIC standards allow the 1-gigabyte-plus drives to read tapes from lower-capacity drives (e.g., the popular 525-MB QIC drives) and permit interchange of tapes produced by different drive manufacturers. The established DDS standard also allows data cartridge interchangeability among the DAT drive manufacturers, but as I've mentioned, the DDS and Data/DAT formats are not interchangeable. Since Exabyte is the sole 8-mm drive manufacturer, compatibility is not an issue.

The different drive types vary in speed. QIC-1000 drives can transfer data at 200 KBps, while QIC-1350 drives offer transfer rates of up to 600 KBps. DAT drives transfer data at a slower 180 KBps. Finally, 2.5-gigabyte 8-mm drives transfer data at 246 KBps, and their 5-gigabyte big brother touts a 500-KBps data transfer rate. Data compression, now used almost universally by tape drive manufacturers, effectively increases these data transfer rates as well as data storage capacities.

Cost is always an important issue. It's likely that QIC drives will maintain the lowest price tag of the high-capacity alternatives, but DAT price drops this past year promise to give QIC some competition. QIC-1000/-1350 drives typically cost between $2000 and $4000, while typical DAT prices range between $2500 and $6000; recent DAT drives, however, have sold for as little as $1500. The capacity-king 8-mm drives will probably remain the premium backup alternative for the foreseeable future, generally costing well over $5000 for a 2.5-gigabyte model and over $10,000 for a 5-gigabyte unit. Media costs for all the drives are similar, at between $20 and $40 per cartridge.

Future capacity increases for the competing tape drive technologies are unclear. Current QIC plans call for capacity increases to 35 gigabytes within five years. DAT will probably reach 5 gigabytes within the next two years but may not go much higher. Similarly, Exabyte is expected to introduce a drive with an 8- to 10-gigabyte capacity within the next two years, but further capacity increases may be slow in coming.

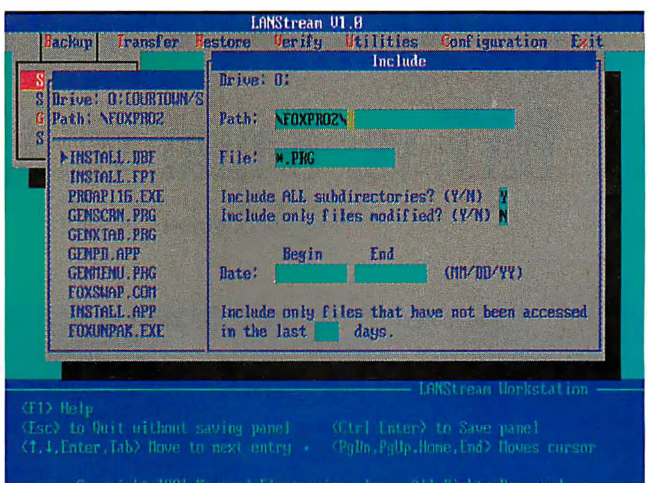
Roger C. Alford, a BYTE consulting editor, is president of Programmable Devices, a Michigan-based electronics design firm. He can be reached on BIX as "rogera."

limited and unreliable. The preempting feature will not work in graphics mode or if your program is making DOS calls or accessing the hard disk.

If you prefer, you can set up batch files to automatically perform your backup chores. This takes some knowledge of DOS batch files, but Mountain offers help both in the documentation and by providing useful samples on disk. Mountain's standard bkall batch file does a full backup of all workstations. We added just a few lines and included full backups of all the file servers as well.

The FileTalk software provides a solution for backing up local workstation disks across the network (based on the Pipes peer-to-peer kernel). Published drives appear across the network with a user prefix (e.g., BILL:C:). You can back up any published drive from the administrator's station as if the disk were local.

We found FileSafe to be reliable and solid, if a bit slow and unresponsive at times. It will do the main job of LAN backup, but it can't help you with scheduling, tape rotation, file grooming, and other advanced administrative tasks.



Screen 2: *The LANStream interface lets you select files from a directory tree. From pop-up boxes, you can exclude or include sets of files using DOS wild cards and other filters such as date stamps and NetWare's last-access flag.*

LANStream 1.0



In automating your backup chores, Maynard Electronics' LANStream doesn't go as far as TNA (see below), but it stakes out a solid middle ground. For instance, LANStream has no rotation software of its own but prompts you for new tapes as needed. You can schedule rotation for an interval of your choosing, and at the appointed time the system asks you for a new tape. LANStream opts for a simple and effective approach, sacrificing some power along the way.

That's not to say that LANStream is a bare-bones offering. Far from it. The software treats tape drives as shared devices so that each workstation can access the drive and schedule a wide assortment



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of jobs. One workstation on the network becomes a dedicated tape server. Ideally, you'd run the server software at the end of the day and schedule your tape backup jobs after hours. Another approach might be to set up a system and dedicate it to running the LANStream server software. You can perform certain administrative tasks from the tape server, but the bulk of the work—backup, restores, transfers, and scheduling—would be performed by the LANStream workstations.

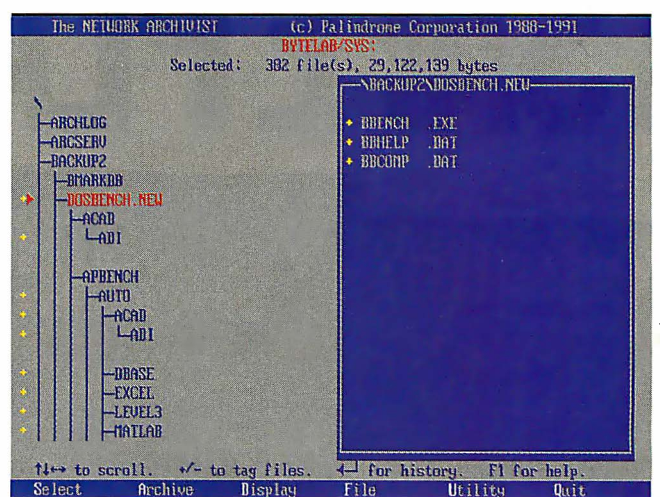
To manage data on the network, LANStream employs NetWare's Btrieve. (You'll need Btrieve 5.16 or higher to get up and running.) We had to acquire an update patch, and even then the NLM reported some intermittent errors. Each client on the network who wants to access the tape server must install a copy of the workstation software. The software assigns the NetWare log-in name to the installed workstation, so if you have people sharing a single workstation, they have to share a single NetWare account.

Once the software is installed, the workstations can tap the tape drive as a shared resource. Each workstation's capabilities are limited by a combination of the user's NetWare and LANStream privileges. From the workstations, users can back up mapped NetWare drives as well as their local drives. They can also run a TSR (i.e., IsleLAN) and publish their local drives for other workstations on the network.

The software presents an easy-to-use menued interface. From the workstation, three basic tasks are available: backup, restore, and transfer; each task has a pull-down menu associated with it. To perform an operation, you choose the appropriate menu and select the files you want to work with. You can select entire drives, a range of subdirectories, or individual files. Files can be included or excluded by wild-card designators or date ranges (see screen 2). By selecting the Transfer operation, you can perform selective file "grooming" by transferring only those files not accessed in, say, 180 days (you can select any period up to 999 days). The files selected would then be copied to the tape drive and removed from the network drive.

LANStream makes it easy to create scripts. You simply select the operation you want scripted, designate the files to be included in the operation, and then select a menu option to save the script. The integrated scheduler lets you set up jobs to run at a particular day and time or at any interval you designate.

LANStream also supports multiple drives on the tape server. Each tape drive can be limited to a particular group of users (e.g., a department) or even to different operations (e.g., a tape drive could be set up for restore jobs only). This type of flexibility is LANStream's greatest strength. If you want a single administrator to be in charge of backup operations, that's no problem; users can simply publish their drives. On the other hand, you can off-load some of the administrator's responsibilities by leaving it up to the users to back up their own local drives while the administrator backs up the network. It's a nice compromise between the fully automated TNA approach and the traditional manual approach. You have the tools to do what you want, but it's still up to you to set up an efficient backup strategy.



Screen 3: *For manually archiving files onto tape, The Network Archivist provides an easy, point-and-shoot menu system. Automatic operations take care of themselves.*

The Network Archivist 2.0



Palindrome's TNA (see screen 3) is easily the most ambitious of the backup packages we looked at. It doesn't treat your backups as a series of tapes, but rather as a vast collection of data that just happens to be scattered among a series of tape sets. In short, you don't use TNA to copy data onto tapes, but to manage your files, and you trust it to handle the tapes any way it wants.

The way the package likes to work is through fully automatic tape rotation using a Tower of Hanoi algorithm. Popular among the minicomputer and mainframe crowd, this algorithm chooses among five or seven tape sets, depending on the parameters you select. This scheme improves on the standard father-son algorithm by making more versions of your data available with less tape and less backup time.

You start by doing a full backup to one tape set—call it A. The next day's tape will be B, and so on until you get to G. The rotation scheme calls for G to be updated every 2 days, F every 4 days, E every 8 days, and then back to A and B, which each get updated every 16 days. The algorithm gets its name from the children's game that uses a stack of different-size disks and three poles. The idea is to transfer the entire stack of disks from one pole to another by moving one disk at a time and always placing a smaller disk on a larger one. For every disk (i.e., backup tape) you add, the number of moves (i.e., backups per rotation) will double.

To save on the amount of data written to tape, TNA considers that any data that has been stored onto three tapes without being changed is *saved* and that data won't be written to tape again. The software tracks the file's access history and, once it becomes stable, makes sure that it resides permanently on three tapes. Some time later (12 weeks by default), the file becomes eligible for migration or grooming. At the administrator's discretion, eligible files can be identified and purged from the file server. The file will be replaced with a zero-length phantom file and flagged in TNA's database. If your PC then tries to access the file, TNAFNTOM (a DOS TSR) will trap the access and tell you that the file has migrated to tape.

For workstation backup, TNA uses a pair of TSRs, TNAWS and TNACNTRL, based on Fresh Technology's Map Assist, a NetWare peer-to-peer networking package. TNAWS makes your workstation's drives available to other workstations, and TNACNTRL lets the backup

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workstation see the mapped drives as local. Straight out of the box, TNA will manage up to 350 MB of data per network. As your network grows, you can add more coverage with extension disks: The first boosts TNA's capacity to 1.3 gigabytes; the second gives you the ability to manage unlimited amounts of data.

Our only reservation about TNA is that it may be *too* automatic. Tape backup should be a system administrator's responsibility. If a file server crashes and needs to be restored, it's the administrator's responsibility to restore the right files from the right tape. TNA follows a complicated algorithm and makes a number of decisions on its own without any human input. With the disk database destroyed, TNA needs you to insert the correct tape to rebuild it, and it won't know which tape it wants. If you haven't been paying attention to the rotations, you may not know, either. Tape recovery works well. The only way we found to confuse it horribly was to manually scramble its disk database.

If you wind up using TNA, we suggest you keep a small calendar nearby and jot down the tape-set ID it asks for each day. That way, if a catastrophic event occurs, you won't have to guess which tape is which and possibly restore old files by mistake. TNA's attention to data security makes it a superb choice for most LANs. Just remember—it's *your* data, and ultimately you have to take responsibility for protecting it. TNA will do the hard part; all you have to do is watch and pay attention.

Powersave 2.2

DOS

Offering a well-organized menu-driven interface, Performance Technology's Powersave is easy to install and use. Unfortunately, the software pales in comparison to the new breed of automated, full-featured programs such as ARCserve, LANStream, and TNA.

The main menu offers basic options, including save, restore, and utility selections. From the save menu, you can select an entire network or pick specific subdirectories and files. The interface includes smooth mouse support for triggering menu options and selecting drives or files. It also features sliding bars to indicate the progress of backup and restore operations—handy when you're waiting for long jobs to finish.

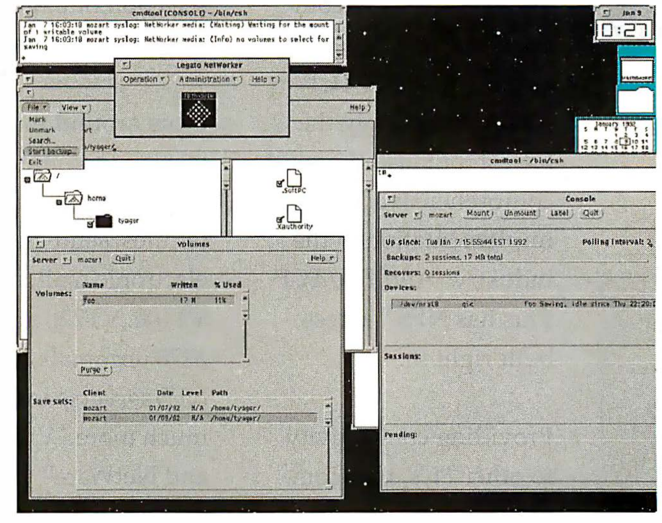
The utility menu option lets you check a tape's contents or perform diagnostics and maintenance tasks. From this option, you can also create automated scripts. The software creates a batch file and a data file containing control instructions passed to the batch file. You can then conduct an unattended backup session by running the batch file. The batch file performs the backup by using a command-line version of the software along with the parameters supplied by the data file. A "wait" option will hold the backup job until a specified time.

Powersave provides some of the sophisticated features of the more advanced packages, but they are not implemented in a very sophisticated way. For instance, background scheduling is offered via a bundled TSR that will run any DOS batch file at a specified time. The program simply squirts out the character string needed to start the batch file at the appointed time. As long as you are sitting at an inactive DOS prompt, it works fine. When we were in an application, however, the character string was simply fed to the application.

The solution for backing up workstations on the network also falls short. Each workstation has to run an access application, becoming in effect a temporary file server. While it is waiting to be backed up, the workstation cannot run any other application software. Workstation backups proceeded without a hitch, but other solutions offered in this review work as well without tying up all the resources of the workstation.

We also had some reliability problems with the software. When our backup job required a second tape, Powersave ejected the first tape and then refused to accept a new one. We were unable to recover data from the first tape. We also had some problems running the software with a supported 8-mm tape drive. Technical support, although helpful, was unable to re-create the problem.

Powersave works well as a simple utility for backing up local and network drives. It's quite fast and very easy to use. However, if you want the advanced features of today's more sophisticated LAN backup software—scheduling, tape rotation, and grooming—you'll have to look elsewhere.



Screen 4: *NetWorker's GUI includes a graphical file-selection window and a console screen that constantly reports the status of the backup server.*

Legato NetWorker 3.0



Legato Systems' NetWorker is an elegant solution to a very complex problem. Its emphasis is on automating the organization that's needed to manage backups, particularly for large networks of systems. It's appropriate, therefore, that NetWorker calls on you to do a small amount of advance setup. It ships with a reasonable set of defaults, but it clearly works best when you lay out a backup strategy in advance and use NetWorker's facilities to manage that strategy for you.

The basic plan is this: You create a library of tapes (NetWorker handles QIC, 8-mm, 4-mm, and reel-to-reel tape) and mark each tape with two labels: one that you write on the outside, and one that NetWorker encodes both on the medium itself and in an index file on the backup server's disk. Backups can be kicked off automatically by NetWorker, based on a schedule that can be applied systemwide, on a per-system level, or to a group of related systems. Systems that are running the Legato client software can also request backups and restores through the network.

Because Legato NetWorker maintains

a detailed index on the server's disk (an index that can be restored in the event of a server failure), a restore request can be filled quickly; a message appears on the server's console instructing the operator to insert the appropriate tape. NetWorker's index files can also be queried. If your archives contain several versions of a single file, for example, the index will let you restore any one of them.

As we said, NetWorker is plainly built with large networks in mind. It eases the management of multiple servers, multiple backup devices per server, multiple simultaneous client requests, and so on. Because NetWorker writes label data onto each tape, the common error of inserting the wrong tape or writing over an old volume is minimized. Finally, Legato's documentation includes an extensive tutorial on planning backup strategies.

NetWorker is actually a set of Unix command-line utilities that act together to handle backups and restores, tape library management, data compression, and other functions. On the Sun/SPARC version, a very effective Open Look interface is included that ties the utilities together (see screen 4).

NetWorker uses a proprietary scheme for writing the data to tape and will apply compression at your discretion. In our tests, compression seemed to work very effectively, reducing a 30-MB test backup tree to a reported 8.6 MB on tape. This surprisingly high compression ratio was partly due to a high percentage of source code files in the test tree, but Legato still deserves credit for such an effective compression scheme. It took 6 minutes to write the compressed 30 MB to tape; that's a solid 5 MB per minute, but compression played a role in that, as well.

NetWorker's interface is impressive. It's very easy to learn and use, and the file-selection mechanism (invoked by clients posting a backup request to the server) is easy enough for even the most inexperienced users to understand.

BudTool 4.0



Delta Microsystems' BudTool 4.0 is a step away from the self-contained, proprietary approach of Legato NetWorker. BudTool is a set of programs and user-interface elements that form wrappers around existing Unix backup utilities like `tar`, `dump`, and `cpio`. What's more, while NetWorker's emphasis is on tight control and ease of use, BudTool appeals more to experienced Unix system administrators.

Many elements of BudTool are similar to those of NetWorker. BudTool maintains server-based databases of tapes and schedules and can handle both automated and manual backup requests. Also similar is the way in which clients can post backup requests through the network. In fact, both packages serve roughly the same purpose and offer roughly the same set of capabilities. There are, however, some important differences.

Because BudTool uses standard Unix commands, the data on the backup tape can be read by any system, even one without BudTool. The converse is not true, however; you can use BudTool only to manage BudTool tapes, because of the required label file placed at the front of each tape.

While portability can be seen as an advantage, it carries all the disadvantages of whichever Unix program is chosen to handle the transfer. Some are slow,

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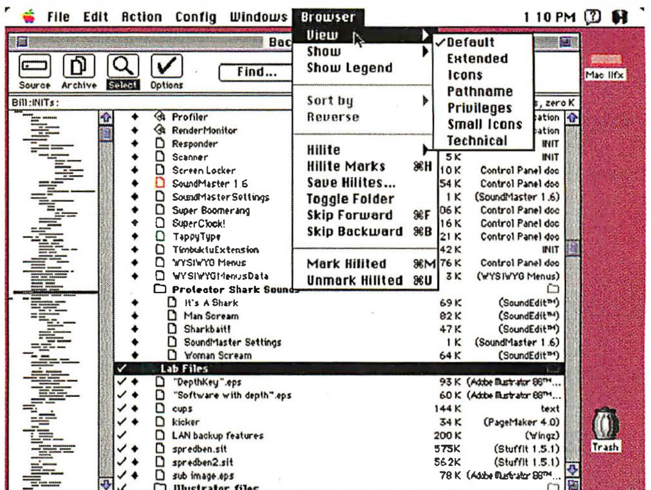
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others can't span multiple tapes, and all lack the ability to compress data. While some administrators prefer to do without it, we can't imagine backing up a large network without data compression; it seems like a waste of expensive tape. To its credit, Delta Microsystems does include an option for creating a custom backup/restore command. You can specify a pipe sequence that includes compression and decompression.

BudTool's interface is somewhat sparse compared to Legato NetWorker's, but it seems to cover all the bases. The file-selection dialog box isn't as elegant, either, but the basic ability to mouse around to select files is supported.

Overall, BudTool is an extensible set of network backup tools for advanced system administrators. The back of the manual lists the formats for all the internal files used by BudTool's various modules and also includes a description of a language used to generate tape labels from symbolic expressions. This is an incredibly versatile foundation for a network backup system, but its best audience is those who are prepared to invest a lot of time in tuning and configuration.



Screen 5: *Retrospect's Browser window is the heart and soul of the package. This is the default view of a single drive, but you can select from a number of views depending on the level of detail you need.*

Retrospect Remote 1.3



The regular version of Dantz Development's Retrospect, which supports many different kinds of tape drives, is included with a number of tape drives and Iomega's Bernoulli 90 removable cartridge drive. Retrospect Remote is simply an extension that gives the program access to workstation disk drives.

After an easy installation, you fire up the application on the backup Mac and choose "Remotes" from the configuration menu. Retrospect looks out on the network and gives you a list of all the machines (by name) that are currently running the Remote INIT. You activate each workstation by assigning it a unique ID

number (three come with the package; you buy extra ID numbers up to a total of 2400). Once you assign an administrator's password to the backup workstation, your network is secure. If you like, you can have Retrospect encrypt the data moving over the network so that AppleTalk packet snoopers can't see anything recognizable.

The interface is all Macintosh. Protected volumes appear by name and icon, and workstations, local hard drives, and file servers all appear interchangeably. To access specific files on a volume, you just click on the volume and bring up a Browser window (see screen 5). Each file and folder appear in hierarchical order, with a very nice thumbnail on the left and each selected file marked with a check.

Backups are managed in a backup set, to which you assign a name and a set of backup rules. The set keeps track of a list of files it knows to be on tape. Scripts automate the process of selecting multiple volumes and applying access rules. For example, you may decide that on Monday you want to do full backups and that on Tuesday through Thursday you want to back up only the data files that have changed since their last backup. You can specify the backup rules by name, file type, date, and so on, to a dizzying level of detail. A scheduler allows you to have Retrospect Remote automatically start at a given time and run a script.

Besides supporting a wide variety of QIC and 4- and 8-mm tape, the software will back up to any mountable drive, including Bernoulli and SyQuest cartridges. We tested Retrospect with an Archive Python DAT drive, an Irwin 5080 (120-MB) DC2000 tape drive, and a 90-MB Bernoulli drive. With file compression, Retrospect was able to cram about 150 MB of data onto each 90-MB cartridge. Our Mac IIfx is connected to the AppleShare network through standard 230,000-bps PhoneNet wiring, so the network was the gating issue in performance. Our test backups managed to send about 1 MB per minute to the Irwin 5080—not too shabby a showing for a mere LocalTalk network.

Multiplatform Picks

NetWare network administrators will appreciate TNA. Its fully automatic tape rotation and grooming support make backups a breeze. Even so, we'd suggest that you take an active part in the tape rotation by keeping copious notes. If something does go wrong, TNA may need some help in setting it right. If you would rather use a different rotation scheme, then consider ARCserve or LANStream. ARCserve treats your tape drives as a shared file server resource using a familiar NetWare interface, while LANStream uses a workstation on your network as a tape server.

Legato NetWorker and BudTool are perfect examples of the split that exists in the Unix user community. BudTool's appeal is in its ability to combine existing Unix commands, and even custom-developed routines written by the administrator, into a total backup strategy. NetWorker, on the other hand, is completely self-contained and not nearly as adaptable.

We can appreciate BudTool's approach, but we have to give NetWorker the nod here because, of the two packages, it is better suited to supporting the full range of user types. It's easy to use without being condescending, so novices can get the system going without feeling lost, and veterans can use the tools to save time without feeling like they're playing with a toy. NetWorker seemed to be the perfect network backup tool; there wasn't a thing we could imagine wanting to do that NetWorker didn't have available and easily accessible.

Mac network administrators should be more than happy with Retrospect Remote. It's as easy to use as any Mac software we have seen, and it makes the job of backing up remote workstations as easy as pie. ■

The BYTE Lab staff can be reached on BIX c/o "editors."

COMPANY INFORMATION

Cheyenne Software, Inc.
(ARCserve 4.0)
55 Bryant Ave.
Roslyn, NY 11576
(516) 484-5110
fax: (516) 484-3446
Circle 1318 on Inquiry Card.

Dantz Development Corp.
(Retrospect Remote 1.3)
1400 Shattuck Ave., Suite 1
Berkeley, CA 94709
(510) 849-0293
fax: (510) 849-1282
Circle 1319 on Inquiry Card.

Delta Microsystems, Inc.
(BudTool 4.0)
111C Lindbergh Ave.
Livermore, CA 94550
(415) 449-6881
fax: (415) 449-6885
Circle 1320 on Inquiry Card.

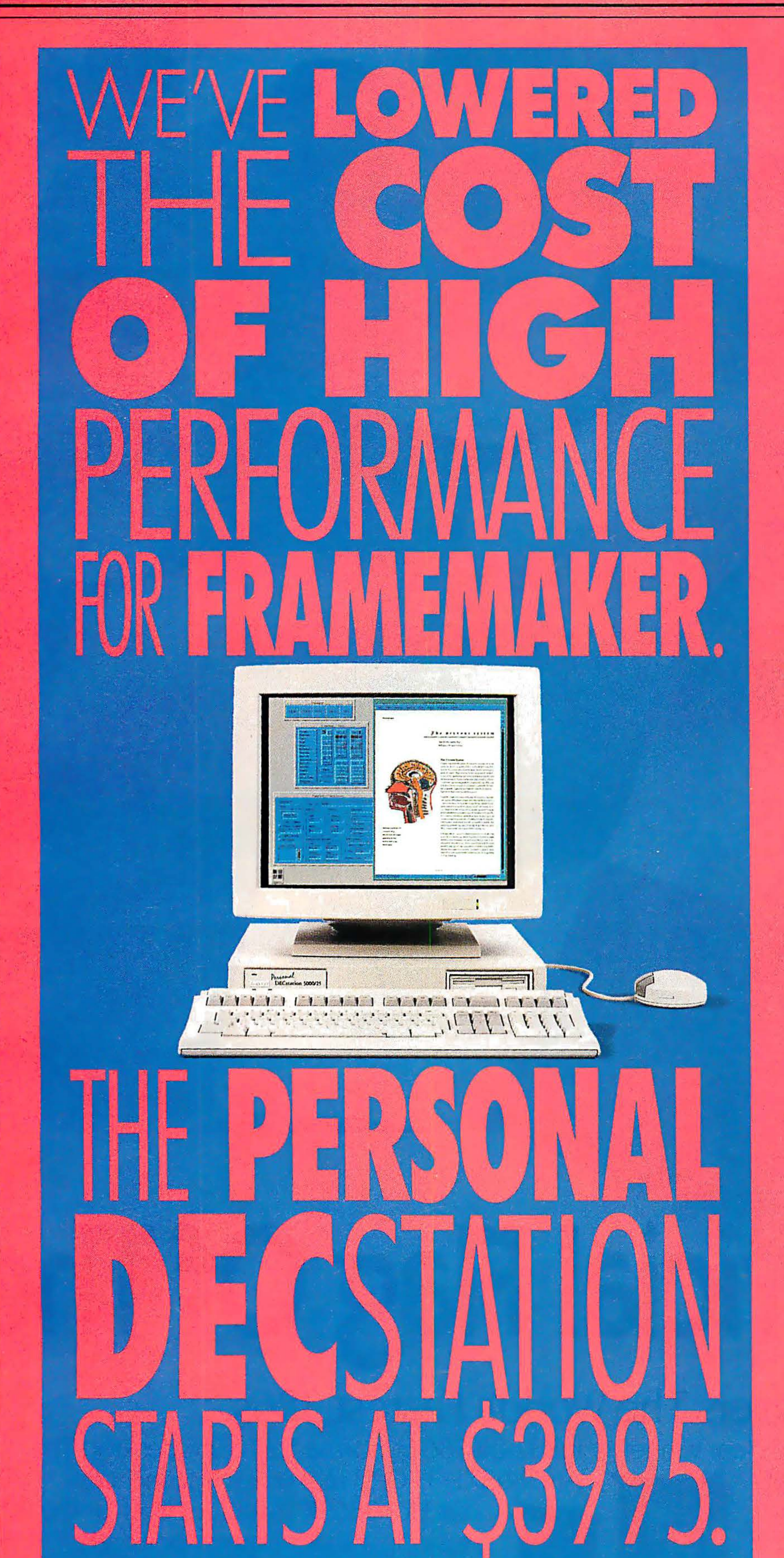
Legato Systems, Inc.
(Legato NetWorker 3.0)
260 Sheridan Ave.
Palo Alto, CA 94306
(415) 329-7880
fax: (415) 329-8898
Circle 1323 on Inquiry Card.

Maynard Electronics, Inc.
(LANStream 1.0)
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Lake Mary, FL 32746
(800) 821-8782
(407) 263-3500
fax: (407)263-3555
Circle 1321 on Inquiry Card.

Mountain Network Solutions, Inc.
(FileSafe 5.2.2A)
240 East Hacienda Ave.
Campbell, CA 95008
(408) 379-4300
fax: (408) 379-4302
Circle 1322 on Inquiry Card.

Palindrome Corp.
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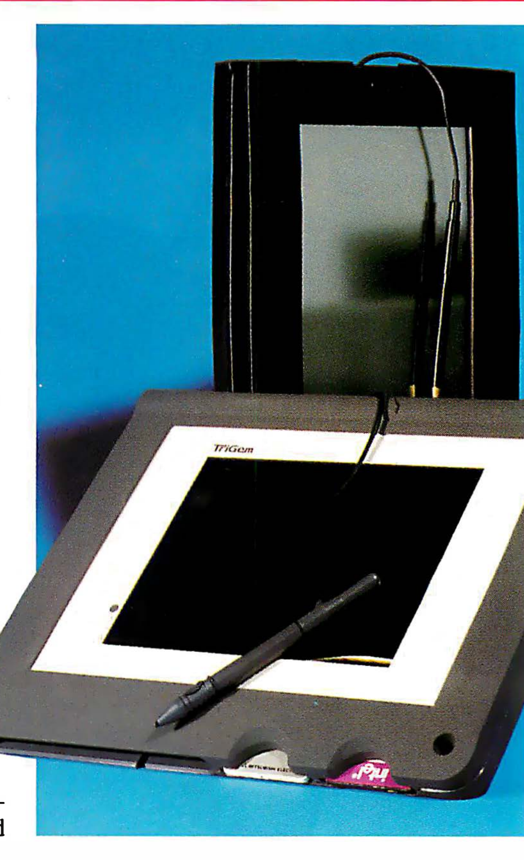
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HARDWARE

Rough Gems: First Pen Systems Show Promise, Lack Refinement

NICHOLAS BARAN



The pen-input system is one of the most exciting recent developments in computer technology. The concept of an untethered, lightweight, notebook-size computer using a pen as the input device is compelling and opens up myriad new applications for computers. However, pen-based computers demand state-of-the-art components in almost every aspect of computer design: battery power and low-power electronics, display and digitizer technology, memory-card storage technology, ergonomics, handwriting recognition, wireless communications, and software development.

Pen-based technology is in its infancy. This review assesses some of the first pen-based computers on the market, including low-end machines using V20 and 286 microprocessors, as well as more powerful machines built on the 386SX. With the exception of the GridPad and MicroSlate Datellite, the machines reviewed here are among the first off the production lines. Several machines that made a big splash when announced (including NCR's 3125 and Samsung's PenMaster) weren't available, and much of the support software for these systems is still in development.

First Pass

Like the PCs of 10 years ago, these machines represent the first generation. In the next few years we'll see great improvements in many of their features and components, including display contrast and readability, battery life, weight, and form factors. Pen-based software will also make great strides in the next few years—faster and more accurate handwriting recognition, more "pen-centric" applications, better graphics and data-compression algorithms, and so forth.

But the application of these systems does not lie entirely in the future. The systems in this review are already finding utility in various mobile work environments, particularly those requiring the filling out of forms, such as inspection and appraisal work. And software development for pen-based systems is proceeding at a furious pace. Pen-based computers have arrived.

The First Pen Systems

I looked at five machines: the GridPad HD from Grid Systems, the TraveLite from DFM Systems, the Datellite 300 from MicroSlate, the Momenta Computer from Momenta, and the TriGem Pen386SX from TriGem. I evaluated them strictly on their merits as notepad computers in a mobile environment, although you can attach keyboards and use them as laptops or desktop machines.

All these machines weighed at least 4.5 pounds. Although that may sound light, it's pretty heavy in the crook of your arm. For comparison, *Webster's Ninth New Collegiate Dictionary* weighs slightly over 3 pounds. For pen systems to feel truly natural to the user, they will have to weigh no more than 3 pounds; I've tried the NCR 3125, and, at 3.3 pounds, it's barely acceptable.

Measuring battery life is difficult, since it depends on how the machine is used. Most of these machines have a low-power standby mode that shuts down the display and hard drive when the machine is idle. And, of course, many users will turn off the machine when they're not using it. Obviously, the actual battery life will vary greatly depending on how long the machine is powered on and the type of computing activity (e.g., activating the modem or performing lots of data transfers to disk will run down the battery faster than, say, scrolling through a RAM-resident reference document).

BYTE's standard battery-life test for notebooks relies on a script-driven hardware test rig that monitors the LCD screen and uses the keyboard to wake the machine when appropriate. Unfortunately, I wasn't able to use this test method for these machines without keyboards. Instead, I compared the machines' battery life by repeatedly running BYTE's system benchmarks until the batteries ran down. The BYTE benchmarks are compute- and hard disk-intensive and provide a worst-case scenario for testing battery life.

It was not easy to evaluate the software on the machines, since much of it is still in development or in beta testing. The NEC V20-based GridPad and the 286-based TraveLite run only DOS (Grid's PenRight environment runs on top of DOS). Thus, these machines won't be able to run Windows for Pen Computing, Go Corp.'s PenPoint, or Communication Intelligence Corp.'s (CIC) PenDOS, all of which require a 386 processor (a 286 machine can run Windows for Pen Computing, but poor performance makes this impractical). The Momenta Computer is a dual-boot machine that runs standard

Five of the first: These pen-input machines, ideal for mobile-computing applications, represent the first generation of pen-based systems. From left to right: the TriGem Pen386SX, the GridPad HD, the DFM Systems TraveLite, the MicroSlate Datellite 300, and the Momenta Computer.

BYTE ACTION SUMMARY

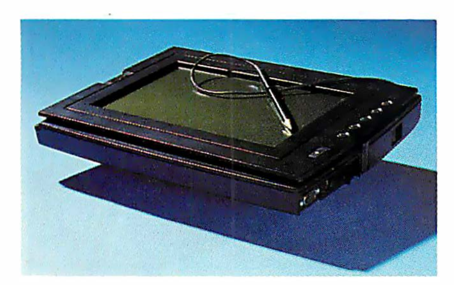
- **WHAT PEN-INPUT SYSTEMS DO**
  These first-generation pen-input systems provide an intuitive, pen-based interface for mobile-computing applications.

- **LIKES**
  The pen interface is compelling, and these machines will provide excellent platforms for data-collection applications.

- **DISLIKES**
  There are technical hurdles that need to be overcome before these systems are truly practical. In particular, weight, display readability, and battery life must improve.

- **RECOMMENDATIONS**
  For forms-based data applications, the GridPad HD is a good choice. For more advanced applications that will require Windows for Pen Computing, PenDOS, or PenPoint, you may want to wait until more players enter the market; if you can't wait, the TriGem Pen386SX is worth a look.

Windows 3.0 or the Momenta Environment. The TriGem and MicroSlate machines came with a beta version of Windows for Pen Computing.



Grid Systems GridPad HD

The GridPad HD is the most established member of this group of pen-based systems. The first GridPad shipped in early 1990—the first pen-based computer on the market. Based on the Intel 8086 architecture, the GridPad is basically an MS-DOS machine customized to accept pen input. Grid Systems has announced a 386 version of the GridPad, but it is not shipping as of this writing. The GridPad software includes an on-screen keyboard so that you can execute DOS commands using the pen.

The key to the machine is the development of custom applications. Using a variety of software development tools provided by Grid and third-party software developers, it's possible to develop custom applications for specific tasks. The machine has enjoyed some success in various vertical applications; for example, the city of San Francisco has been using GridPads for a post-earthquake building inspection program.

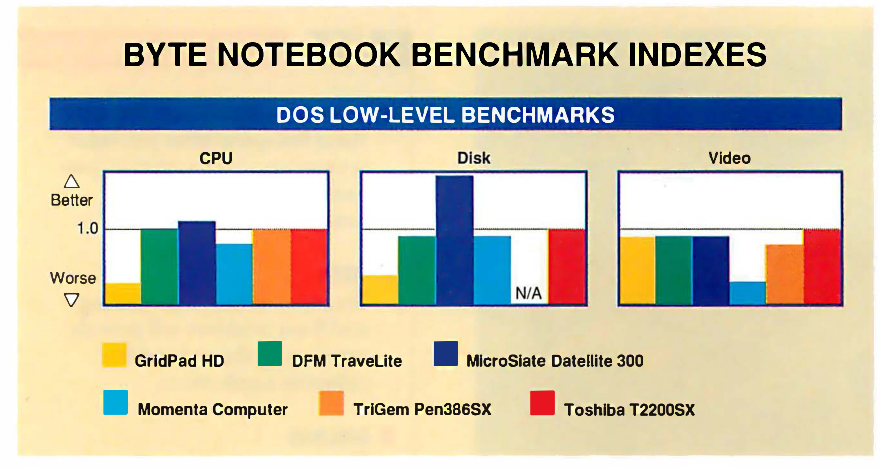
I evaluated the GridPad HD, a 10-MHz NEC V20 model with a 20-MB hard drive and a PCMCIA-compatible RAM card slot for backup and software installation. The model I tested weighs about 5 pounds (Grid claims 4.5) and has a 640- by 400-pixel, CGA-compatible, 10-inch backlit display. The machine is powered by an external power supply or by internal nickel-cadmium batteries.

The GridPad measures roughly 12 by 9 by 1½ inches and fits comfortably in the crook of your arm. It is well constructed, and the readable backlit display provides good contrast. The system includes configuration software that lets you turn off the backlight for outdoor use, extending battery life. The configuration software also provides options for controlling power management and other display attributes. The system comes with a well-written user's manual describing features and configuration options.

The pen is attached to the unit by its cord; it clips neatly on one side of the machine. The display is oriented horizontally with five programmable function buttons on the right side. The pen cord also connects on the right side, making left-handed use of the pen more inconvenient, since the cord drags across the screen.

When the machine boots, you are presented with a menu that lets you run the sample applications, switch to DOS, or perform diagnostics or configuration functions. You access all menu options simply by highlighting the option with the pen and then tapping on the Execute box. When you switch to DOS, an on-screen keyboard appears from which you can execute standard DOS commands using the pen as an input device, simply by tapping on the appropriate keys. I was impressed with the accuracy of the pen and the sensitivity of the digitizer.

The sample applications were a bit spotty. A sample expense report program sometimes refused to accept handwriting; the Grid Handwriting Tutorial didn't work at all. However, a legal briefing program with sample forms to fill



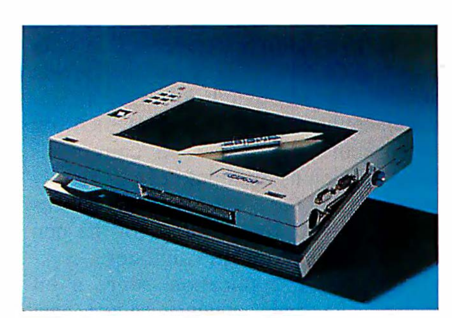
Low-level benchmark results for pen-input systems. The 20-MHz 386SX-based TriGem and Datellite systems did well, but there was relatively little variation. The Momenta Computer scored poorly, with low scores on memory-move tests. Toshiba's T2200SX is included as a baseline for comparison.

out worked very well. While frustrating, these problems are in the sample applications only and do not reflect an inherent problem with the machine or operating system.

Of the machines reviewed here, the GridPad is the only 8086 system. Naturally, its performance benchmarks are lower than those of the 286 and 386SX systems (see the figure). But for many custom applications, particularly simple forms, its performance is adequate.

Perhaps the GridPad's most impressive feature in comparison to the other machines is its battery life. The batteries held up for over 3 hours of continuous use. Along with MicroSlate's Datellite, the GridPad was a leader in battery life.

The system I reviewed sells for $3570. That's a lot of money for an 8086-class system. It won't run Windows, PenPoint, or PenDOS. However, it is well built and has a proven track record. If you need to jump in right away and do some basic forms-oriented pen-based computing, the GridPad is a viable option.



DFM Systems TraveLite

The TraveLite is included in this review because it can be operated without a keyboard, but it is actually a touch-sensitive system rather than a pen-based system. It comes with a plastic pointer shaped like a ballpoint pen for touching the screen, although you can also use your finger or the eraser of a pencil, for that matter. Like the GridPad, it has an on-screen keyboard for entering commands. The TraveLite does not recognize handwriting, but you can draw on the screen with a drawing program.

Roughly the same size as the GridPad, the TraveLite that I tested has an 80C286 CPU and a 20-MB hard drive. The system comes with a special cable that connects to the parallel port of another IBM PC compatible, giving the TraveLite logical control of the drives on the connected machine. This is the method for transferring data or installing software on the TraveLite.

The machine that I evaluated came with DR DOS 5.0 and a few sample applications. It included an optional detachable keyboard and a fax modem. DFM Systems has developed drivers for emulating the mouse in the touchscreen environment, presumably for use with Windows. However, Windows really favors a 386 processor.

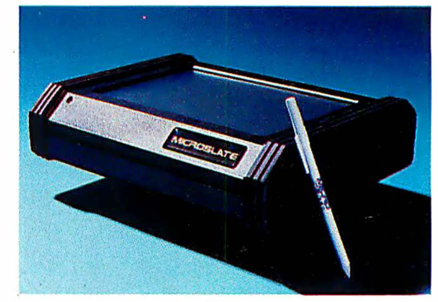
The system also includes a condenser microphone for making short voice recordings and an optional voice board for delivering digitized speech.

The TraveLite is designed, much like the GridPad, for custom applications, such as forms entry. The system comes with applications development software called the EasyTouch Application Generator, which is documented in a three-ring binder. Other than the EasyTouch binder and the DR DOS user's manual, the documentation is minimal (a 12-page photocopied pamphlet is the extent of the user's manual).

The biggest disappointment with the TraveLite is its battery life. My benchmark exercise exhausted the TraveLite batteries in less than an hour. I tried the test several times, charging the nickel-cadmium batteries overnight after they had completely discharged, with the same result. The system has minimal power management and does not power down the hard drive when it is not in use, which could be part of the problem. In any case, DFM Systems needs to go back to the drawing board with its power management system.

This machine will appeal to applications developers working on turnkey mobile applications. The problem is that EasyTouch is a proprietary development environment, which will not attract software developers. And most nonprogrammers developing their own applications will find the system technically difficult to work with.

Without the keyboard and fax modem, the system I tested is priced at $3466—again, pricey for a low-end system. The company needs to make some major improvements in the documentation and in power management. On the positive side, the machine could be a good choice for simple forms applications, much like the GridPad, provided that battery life improves.



MicroSlate Datellite 300

Like the TraveLite, the Datellite 300 is a touchscreen computer. However, it is more capable than the TraveLite, sporting a 20-MHz 386SX microprocessor and support for Windows for Pen Computing. The unit I evaluated included a 60-MB hard drive and 4 MB of RAM.

The heavy-duty Datellite, which the company dubs a "pen 'n touch notebook," is probably sturdy enough to survive a game of touch football. But there's a big penalty for the rugged design—namely, the Datellite's size and weight. The machine weighs almost 7 pounds with its two battery packs installed, and it measures about 13 by 10 inches wide and almost 3 inches thick. This would be

PEN-INPUT SYSTEMS

Although these systems are all designed for pen input, they display a noticeable difference in configuration.

Product	GridPad HD	Datellite 300	Momenta Computer	TraveLite	TriGem Pen386SX
Company	Grid Systems Corp. 47211 Lakeview Blvd. Fremont, CA 94538 (510) 656-4700 fax: (510) 683-9895	MicroSlate, Inc. 9625 Ignace St., Suite D Brossard, Quebec, Canada J4Y 2P3 (514) 444-3680 fax: (514) 444-3683	Momenta Corp. 295 North Bernardo Ave. Mountain View, CA 94043 (415) 969-3876 fax: (415) 969-3877	DFM Systems, Inc. 1601 48th St. West Des Moines, IA 50265 (515) 225-6744 fax: (515) 225-0388	TriGem Corp. 2388 Walsh Ave., Building B Santa Clara, CA 95051 (408) 970-0844 fax: (408) 970-0870
Tested configuration	10-MHz NEC V20 CPU; 2 MB of RAM; 20-MB hard drive; 10-inch, 640- by 400-pixel LCD	20-MHz 386SX CPU; 4 MB of RAM; 60-MB hard drive; 9½-inch, 640- by 480-pixel VGA LCD	20-MHz 386SX CPU; 4 MB of RAM; 40-MB hard drive; 9½-inch, 640- by 480-pixel VGA LCD; detachable keyboard; internal fax/modem	12-MHz 80C286 CPU; 1 MB of RAM; 20-MB hard drive; speech board; backlit, 10-inch, 640- by 400-pixel LCD	20-MHz 386SX CPU; 4 MB of RAM; 4 MB of flash memory; two PCMCIA memory card slots; 9-inch, 640- by 480-pixel VGA LCD; programmable border area; external power supply with serial port
Weight (lbs.)	4.5	6.6	6.3	5.5	4.9
Price	$3570	$5995	$4995	$3466	$3995
	Circle 1228 on Inquiry Card.	**Circle 1229 on Inquiry Card.**	**Circle 1230 on Inquiry Card.**	**Circle 1231 on Inquiry Card.**	**Circle 1232 on Inquiry Card.**

a tough machine to carry in the crook of your arm for any length of time. The machine has a handle so that you can carry it like a briefcase. Nevertheless, the size and weight of the machine make it a questionable notebook.

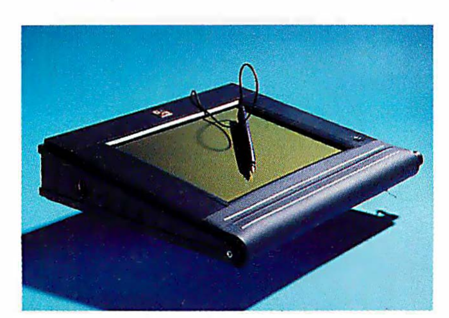
On the plus side, the Datellite is one of the better-constructed machines I looked at. It has a solid battery life of over 3 hours, and it offers good performance. The VGA-compatible backlit LCD is easy to read and has excellent contrast and brightness. Since it's a touchscreen, you can use any pointing device with it, but MicroSlate provides a package of plastic pens. The machine has an on-screen keyboard for entering DOS commands, and it boots up with a custom menu, giving you the option of executing sample applications or running Windows.

Like the TraveLite and GridPad, the Datellite is intended for custom data-recording applications. The machine comes with a comprehensive set of development tools. Chief among these is the extensively documented DataSlate applications generator.

The Datellite came with a beta release of Windows for Pen Computing. The touchscreen interface worked remarkably well with Pen Windows. I tried the various included handwriting applications as well as other sample programs, such as Slate's PenBook, which all ran without a hitch.

The big problem with the touchscreen interface is the lack of a second button. Most electronic pen systems include a side button on the pen, which acts like the second mouse button on the Microsoft Mouse. Many applications require this second button, as does CIC's PenDOS interface. There are ways around this limitation, of course, but if software developers must provide modified applications for systems without a second button, Datellite software may be difficult to come by.

The Datellite 300 is a well-built and full-featured computer. It even has a SCSI connector for attaching a CD-ROM drive, and it can include a 3½-inch floppy drive. But its size and weight put it more in the class of portables than notebooks. If you have to put the machine down on a workbench to really work with it, then the pen doesn't buy you as much as it could.



Momenta Computer

The "pentop" Momenta Computer is interesting and innovative, designed for both desktop and mobile use. With the keyboard attached, you can tilt the display and use the computer as a desktop, or you can operate it with a pen without the keyboard. However, the Momenta weighs in at over 6 pounds, making it heavy for extended hand-held use. The machine measures 10 by 12 inches and is wedge shaped, making it a bit bulky for the crook of the arm.

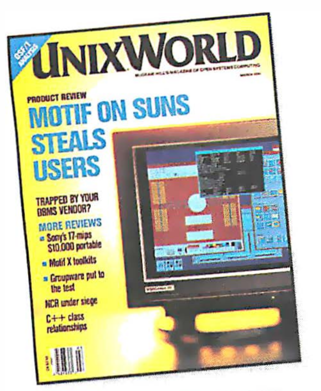
The Momenta Computer is powered by internal rechargeable nickel-cadmium batteries or by an external power supply. The company plans to support standard AA alkaline batteries in the near future and will supply the necessary upgrade to current owners. The pen is tethered by its cord, which plugs into either the left or right side of the computer—a thoughtful design feature for lefties.

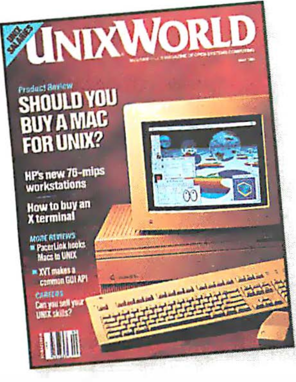
The most interesting aspect of the Momenta Computer is its software. It's a dual-boot machine, booting up either with Microsoft Windows or with the Momenta Environment, which is a graphical pen-interface layer on top of MS-DOS. Windows and the Momenta Environment are mutually exclusive.

Microsoft Windows acts as expected. The pen behaves like a mouse: You can double-tap to open applications, drag the mouse cursor with the pen, pull down menus with the pen, and so forth.

The Momenta Environment is a proprietary GUI designed for pen input and control. It has unique features, such as a command compass, which is a pie menu with options for edit, cut, paste, copy, and delete. The menu appears as a background function behind appropriate icons or fields on the screen. For example, when you're writing characters in a field, you can press the side button on the pen to bring up the command compass, and then perform editing operations on what you've written.

The Momenta Environment is an ambitious software system built on Smalltalk. Its bundled applications include a





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handwriting trainer, a fax program, an address book and calendar, an on-line tutorial, a spreadsheet program, a presentation graphics program, and a text editor/word processor (this application was not ready at the time of this review and is to be included in a free update to all current Momenta owners).

Conceptually, the Momenta Environment is very elegant. You move from one application to another simply by opening the next application with the pen. This feels a bit like multitasking, although task switching is really what's going on. The fax application worked very well. In theory, the environment supports hand printing in all applications.

But although elegant in concept, the Momenta Environment is not quite ready for prime time. The handwriting recognition is inaccurate, much worse than other handwriting recognition systems I've seen. Even after going through the handwriting trainer program, which requires you to print about 12 screenfuls of characters, the system still interpreted my first name NICK as UL36. Users will not tolerate this level of inaccuracy.

Handwriting recognition problems are likely related to the imprecision of the pen. The system provides a calibration program, a tedious procedure in which you tap the pen on a bull's-eye that moves around on the screen, the objective being to ensure that the pen is pointing accurately at objects on the screen. However, the pen is constantly slipping out of calibration. I had to tap about an eighth of an inch to the left of a window's close box to get the window to close.

These problems are only the tip of the iceberg. The reflective display provides poor contrast and brightness, making the screen difficult to read except in very bright light. The compass menu, which is designed to appear in the background, is barely visible. To make a long story short, it takes a lot of effort both with your eyes and with the pen to use this machine. And that is contrary to the intent of pen-based computing.

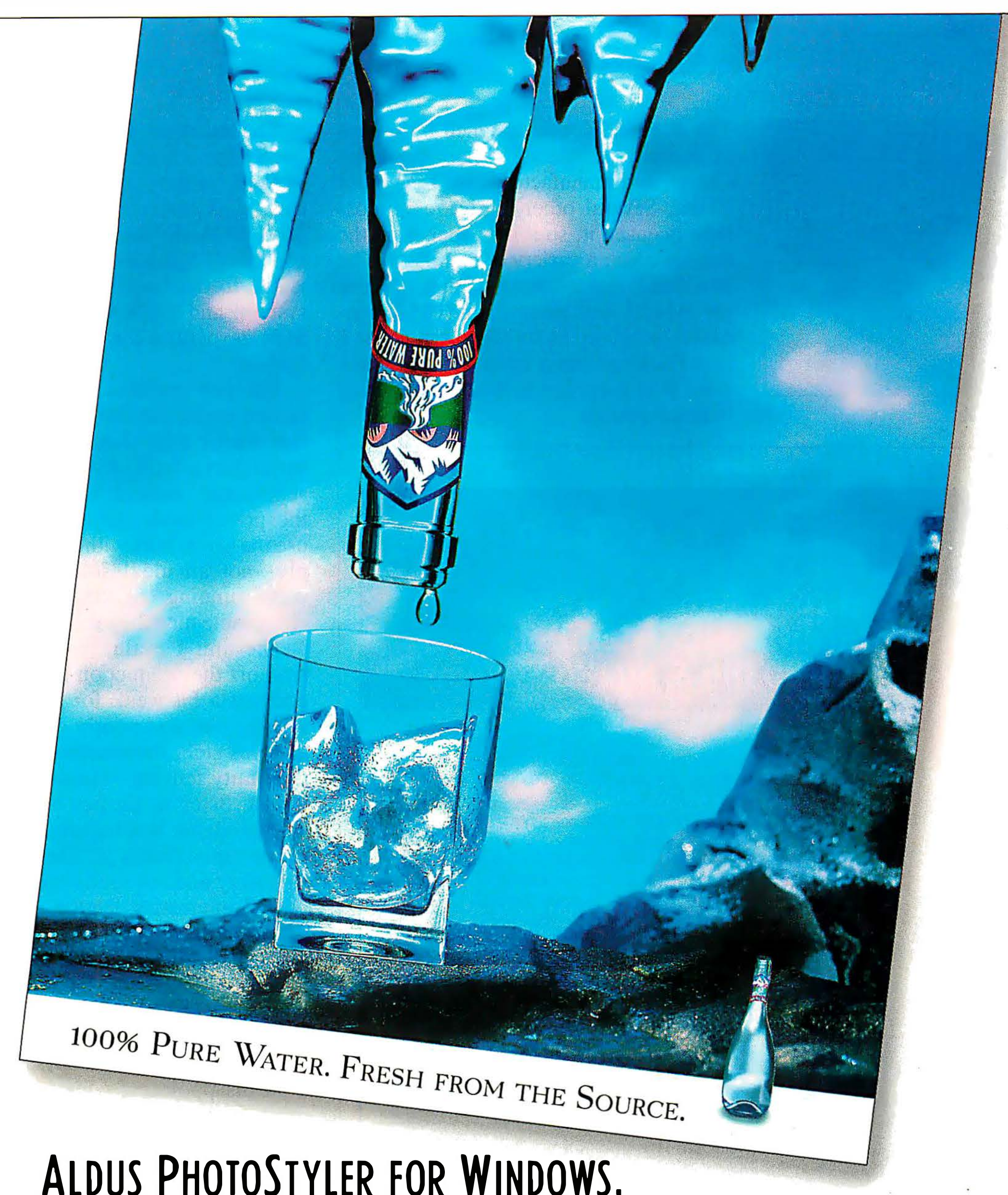
But perhaps the most surprising problem with this machine is its battery life. Momenta claims to have developed some innovative power management techniques for this machine. But when running all out on the BYTE benchmarks, the batteries lasted no longer than half an hour. Each of the two battery packs delivered with the system gave dismal battery-life results.

The Momenta Computer's test results are poor when compared to those of the other 386SX systems. This is probably due to poor performance on memory-move benchmarks. The machine feels even slower when running the sluggish Momenta Environment. When running Windows, the performance is about average for a 20-MHz 386SX-based system.

Momenta plans to address these concerns with a series of software updates; the company plans three updates by July. According to Momenta, these software changes will greatly improve performance in three areas: speed, battery life, and handwriting recognition. System software updates, when available, can be downloaded directly to customers' systems from Momenta's BBS.

The Momenta Computer is a bold and innovative project. But it has been delivered to market too soon. Momenta will need to address a lot of problems with its aggressive software upgrade plans before the system will be competitive, particularly at a price of close to $5000.

continued



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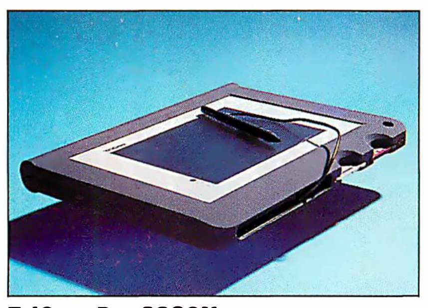
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TriGem Pen386SX

The Pen386SX was designed by a firm in Rainow, England, called the Eden Group, and manufactured by TriGem of Korea. Several other hardware vendors have licensed it, so it may appear on the market under a variety of monikers. The Pen386SX represents what I think will be the typical first-generation 386SX pen-based computer. It's a flat tablet about 1 inch thick and about 10 by 12 inches on a side. It is surprisingly heavy, weighing in at 4.9 pounds.

The machine I tested has a 20-MHz 386SX processor, 4 MB of RAM, 4 MB of flash memory, two PCMCIA memory card slots, and a backlit 640- by 480-pixel VGA display. The flash EPROM consists of 512 KB of boot memory, dedicated to the boot sector and operating system, and another 512 KB (up to 1.5 MB) devoted to the Microsoft flash file system.

The pen operates through a cable attached under the computer. One feature that seems a bit shortsighted is that the serial port is built into the external power supply and connects to the computer via the power cable. Obviously, you can't use the serial port without the power supply—not an ideal solution for mobile users running the computer on the rechargeable nickel-cadmium batteries.

The unit I evaluated was one of the first off the production line. I found the contrast a bit weak for a backlit LCD, and the pen was poorly constructed. On the plus side, the machine had excellent proximity sensing—almost too sensitive, in fact. Bringing the pen near a Windows icon or dialog box highlights the box. A gentle tap activates it. The pen operated smoothly and required little pressure.

One interesting feature is a user-programmable border area about 1 inch wide that surrounds the active screen. Programmers can set up icons and functions that can be accessed in this area.

My battery-life exercises yielded a battery life of about 2 hours. I found this a bit disappointing considering that the machine does not have a hard drive. The benchmark performance was consistent with that of other 386SX machines.

Ultimate Pens

If you urgently need forms-based data retrieval in a mobile environment and can get by with MS-DOS, the GridPad may be a good choice. However, the pen-based market is shifting toward Windows for Pen Computing, CIC's PenDOS, and Go's PenPoint. For these environments, you'll need a 386-based system, preferably with an electronic pen.

I'd recommend waiting until this summer when more machines will be available and at more competitive prices. But for now, TriGem's Pen386SX is the best bet among the systems in this review. With a few improvements, it will be a solid contender in this nascent market. ■

Nicholas Baran is a BYTE consulting editor and coeditor of Pen-Based Computing, *an industry newsletter based in Sandpoint, Idaho. You can contact him on BIX as "nickbaran."*



No question... this 17-inch monitor from ViewSonic is the ideal "big screen" choice for Windows. In fact, in a recent InfoWorld product comparison, the ViewSonic 7 was rated #1. Our monitor was designed for people who know what they want and won't accept second best.

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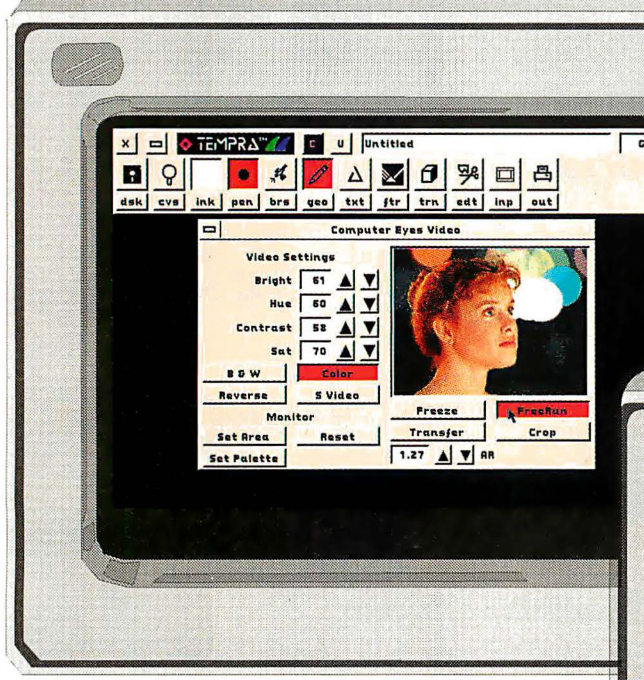
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	Mathematica, Inc. TEMPRA	Corel CorelDRAW	Micrografx Designer	Micrografx Picture Publisher	Aldus PhotoStyler	RIX WinRIX	ZSoft Paintbrush
Drawing Effects	**72**	13	8	64	10	64	8
Drawing Styles							
Arc	**16**	N/A	4	N/A	N/A	N/A	N/A
Circle	**12**	4	8	3	N/A	N/A	4
Curve (Parabola)	**8**	N/A	1	N/A	N/A	N/A	N/A
Ellipse	**8**	4	8	3	N/A	8	4
Freehand	**3**	3	4	2	2	4	3
Irregular Polygon	**2**	N/A	2	3	N/A	N/A	8
Line	**7**	7	6	2	4	8	6
Parallelogram	**4**	N/A	N/A	N/A	N/A	N/A	N/A
Rectangle	**12**	4	8	3	N/A	8	4
Regular Polygon	**24**	N/A	N/A	N/A	N/A	N/A	N/A
Spline (Bezier)	**2**	3	3	N/A	N/A	N/A	3
Square	**12**	4	8	3	N/A	N/A	4
Load/Display Times							
42K PCX	**:03**	:39	:11	:36	:05	:13	:05
330K TIFF	**:04**	:18	:14	:47	:05	:17	:06
289K Uncomp. TGA	**:03**	N/A	N/A	:45	:05	:16	:07
708K Comp. TGA	**:06**	N/A	N/A	N/A	N/A	N/A	:17
Image Formats							
!IM	✓	N/A	N/A	N/A	N/A	N/A	N/A
GIF	✓	N/A	N/A	✓	✓	✓	✓
PCX	✓	✓	✓	✓	✓	✓	✓
PTN	✓	N/A	N/A	N/A	N/A	N/A	N/A
TGA	✓	N/A	N/A	uncompressed	uncompressed	✓	✓
TIF	✓	✓	✓	✓	✓	✓	✓
WIN	✓	N/A	N/A	N/A	N/A	N/A	N/A
Hardware							
Batch Printing	✓	✓	✓	N/A	N/A	N/A	N/A
Scanners	✓	N/A	N/A	✓	✓	✓	✓
Video Capture	✓	N/A	N/A	N/A	N/A	N/A	N/A
B/W Printing	✓	✓	✓	✓	✓	✓	✓
Sierra HiColor VGA	✓	✓	✓	✓	✓	✓	✓
Color Models							
CMYK	✓	✓	✓	✓	✓	✓	N/A
RGB	✓	✓	✓	✓	✓	✓	✓
HLS	✓	N/A	✓	✓	✓	N/A	✓
HSV	✓	✓	N/A	✓	✓	✓	N/A
Environments							
DOS	✓	N/A	N/A	N/A	N/A	N/A	N/A
Windows 3.0	✓	✓	✓	✓	✓	✓	✓
Multimedia/Authoring	✓	N/A	N/A	N/A	N/A	N/A	N/A
Audio Support	✓	N/A	N/A	N/A	N/A	N/A	N/A
Suggested List Price	$149 — $495	$695	$695	$695	$795	$495	$495

All tests were performed on an Orchid Technology Privilege 386-33 with 8MB RAM and a Conner 200MB HDD. Windows applications were tested in 386 enhanced mode with no other tasks running. TEMPRA is a trademark of Mathematica, Inc. All other products are trademarks of their respective owners. TEMPRA speeds clocked before turbo charger feature. Copyright 1991 by Gary A. Klein. All Rights Reserved.

"Mathematica's Tempra 24-bit paint program was another winner, providing unparalled editing speed."
Adam Osborn
NewMedia, November/December 1991

"A top-flight painting/photo retouching program with amazing capabilities. Video speed, even for 24-bit color files, is remarkable. Highly recommended."
Susan Glinert-Stevens
PC Sources, November 1991

"Tempra Pro has some very powerful features. The package's color manipulation and control are hard to beat. Overall, Tempra Pro is an excellent graphics editor that's very easy to use and quite powerful. You will find it possible to create and edit images whether you are a beginner or a professional."
Marc Greenfield
Computer Buying World, November 1991

"Tempra really stands out when working with true-color images. The output from Tempra is excellent. Overall Tempra is a good program. Those who work with full-color images — and any of the supported color scanners — may find it a valuable tool. And the ability to work with video input offers interesting possibilities."
Leonard Hyre
PCM, November 1991

"Tempra gets our nod for PC-based programs. It's the least expensive of the lot and handles a variety of image formats."
Tom Thompson
BYTE Magazine, June 1991

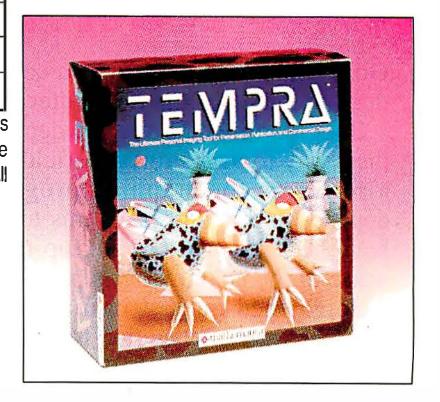




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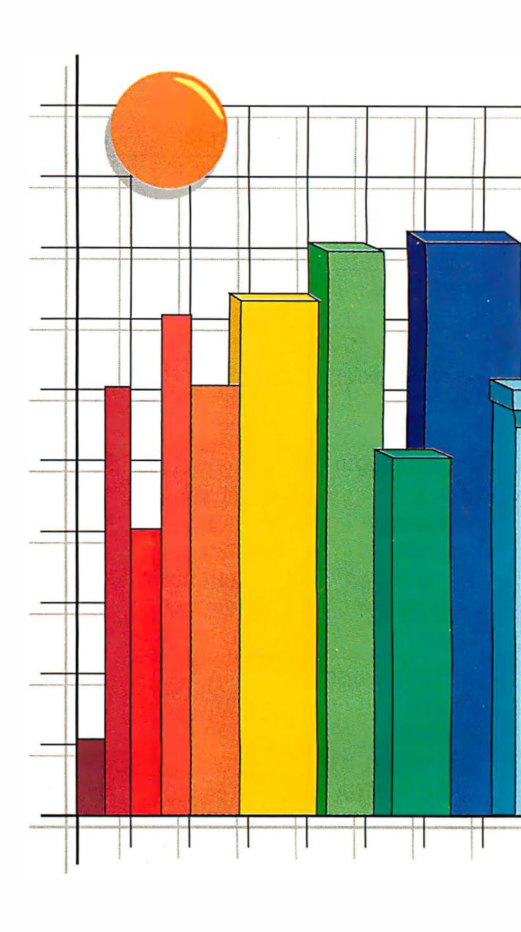


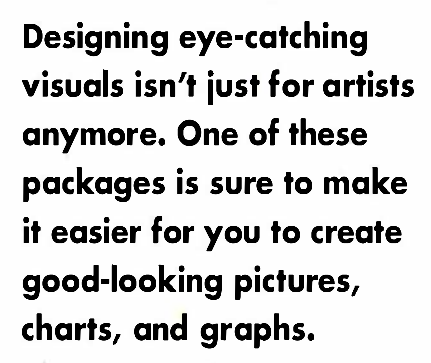
Circle 16 on Inquiry Card (RESELLERS: 17).



ART

For Business's Sake




Designing eye-catching visuals isn't just for artists anymore. One of these packages is sure to make it easier for you to create good-looking pictures, charts, and graphs.

D. BARKER, RAYMOND GA CÔTÉ, DAVID L. EDWARDS, TOM THOMPSON, AND STAN WSZOLA

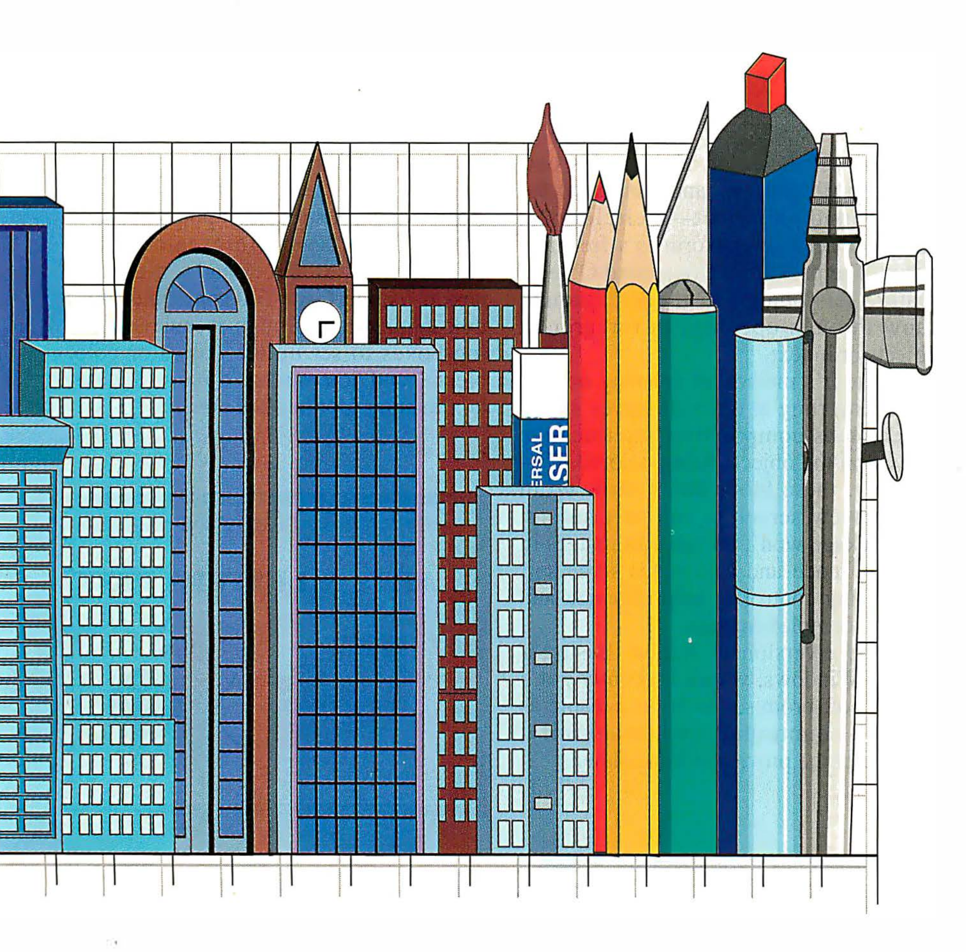
In this highly visual age, looks are nearly everything. And the business of doing business is more closely linked than ever to putting the best-looking graphics forward. Whether trying to communicate ideas, disseminate information, or enhance their corporate image, enterprises today increasingly rely on sophisticated computer graphics software. Drawing, painting, and charting packages are pressed into service for everything from designing logos, developing product designs, and rendering illustrations for manuals or catalogs to making presentations and sprucing up a report or proposal. Gone are the days when you could pass out an unembellished pie chart done up on a dot-matrix printer and expect praise for your efforts.

Once confined to the art department, graphics packages are making their way to desks further afield. Many a spreadsheet ace has developed a fondness for graphing programs, engineers in the lab frequently depend on drawing programs to illustrate new designs, and even CEOs have been known to crank up their favorite charting programs to make sense of the next quarter's projections.

Heightened interest in marrying information and compelling images isn't the only explanation for the growing importance of business graphics software, however. Personal computers that have the horsepower to crank out good graphics are no longer too exotic or too expensive. As a result, an increasing number of IBM compatibles are—like their Macintosh brethren—equipped to handle gloriously realistic color. Likewise, color printers and plotters have come down in price.

Finally, as we found when testing the products for this report, the software itself has gotten more powerful and less intimidating. While it takes practice to master Bézier curves—the design department needn't worry about accountants taking over those job responsibilities—you probably can find a package that overcomes many of your artistic limitations.

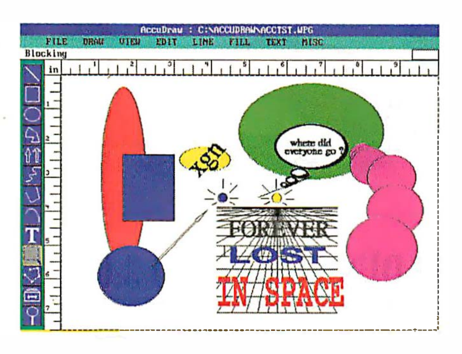
There is, as of yet, no digital substitute for aesthetic sense, but computer graphics programs are here to stay and here to play a critical role in business communications. But how do you even start to choose from the smorgasbord of business graphics software on the market today? Our approach was to search the field. In the process, we turned up nearly 100 programs for PCs and Macs—programs that handle the basic needs of business: drawing, painting, charting, and graphing. (Although slide-show presentations are a big part of business graphics today, we feel presentation software deserves separate coverage.) To maintain our



sanity while taking into account the constraints of space, time, and fairness, we pared the final report down to products we found most effective or ones that are newly revised or new to the market. Ours is not a complete survey of the field; rather it's a subjective roundup of what we consider some of the best software for producing the kinds of visuals today's businesses demand.

DRAWING PACKAGES

If you routinely produce illustrations that are heavy on lines and geometric shapes, or that require precise placement of graphical elements, you need an object-based drawing program. You could go out and buy a CAD package, but unless you're an architect or an engineer, you can get by with something less capable, complex, and expensive. While Aldus FreeHand and Adobe Illustrator are the granddaddies of object-based drawing packages for personal computers, or at least are perceived as market leaders, other programs currently on the market offer similar capabilities but cost less and are easier to learn. For professional illustrators and designers, Aldus FreeHand and Adobe Illustrator still are the top packages to consider. But for everyone else, the choices are both varied and impressive.



ACCUDRAW FOR WORDPERFECT 2.1

AccuDraw 2.1 is a likable DOS and vector-based drawing package designed to support the WPG graphic format of the widely used WordPerfect word processor. It performs basic drawing functions quickly and is also easy to use. Although tailored as a companion to WordPerfect, its ability to import and export a broad selection of files makes it compatible with many other programs, as well.

With 18 drawing tools, 64 fill patterns, 1000 line widths, and over 500 clip art images and symbols included, AccuDraw gives you the wherewithal to create myriad diagrams, floor plans, technical drawings, flowcharts, as well as other

BYTE ACTION SUMMARY

■ WHAT GRAPHICS SOFTWARE DOES

Drawing programs generate line art that can be scaled without distortion; paint packages create realistic images using collections of dots, or bit maps; charting and graphing software provide a wide range of tools to graphically display data.

■ WHAT YOU'LL LIKE

The precise line and curve tools of drawing packages, the color-mixing capabilities and the free-form tools in paint programs, and the simplicity with which charting and graphing programs turn raw data into attractive images.

■ WHAT YOU'LL DISLIKE

The more sophisticated programs take time to learn and run best on high-end hardware.

■ RECOMMENDATIONS

As with art, graphics software is a highly subjective matter. Most of these packages have similar capabilities but differ in their manner of operation and ease of use. The best way to ensure that you get a package that will suit your needs is to compare the capabilities of a variety of products, single out the three or four packages that seem most promising, and get a demo of all of them before deciding which one you'll enjoy working with.

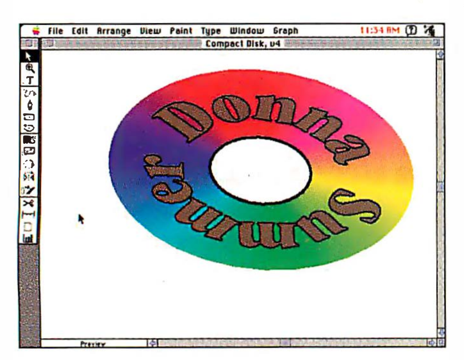
business-type images. The program supports only 16 colors, but then it needs only 400 KB of memory to run.

Because it was developed as a companion to WordPerfect, AccuDraw has some rather unusual graphics file-handling methods that revolve around the WPG format. The bit-mapped graphics from paint programs, clip art libraries, and scanned images can be edited on-screen, or you can convert them to the WPG format with WordPerfect's conversion utility. Any file formats not supported by the program's GRAPHCNV utility can be captured using the GRAB screen-capture program also supplied with WordPerfect.

To edit bit-mapped images, you must use the package's built-in pixel editor. For other editing functions (e.g., moving, scaling, and rotating) a bit-mapped image is treated as a vector object, and pixel data can't be changed. AccuDraw renders pixels into *vector space* using a floating-point calculation for each pixel. Vector objects may be drawn on top of bit maps.

AccuDraw's latest release, 2.11, includes PostScript laser printer drivers, an extrusion function that lets you push an object into the shape of another object, and a feature that lets you draw a curve and then lay text down on it. For the millions of WordPerfect users, AccuDraw has ample tools, is simple to use, and is versatile enough to create respectable artwork.

—D. E.



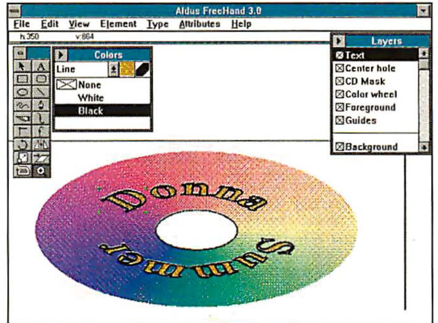
ADOBE ILLUSTRATOR 3.0.1

Still one of the best object-based drawing packages for the Mac, Adobe Illustrator 3.0.1 has an excellent set of drawing tools for freehand curves, text, and objects (circles, rectangles, and so on). Its interface allows you to draw, modify, and color objects with a minimum of fuss and great precision. On top of that, Illustrator provides ample text-handling capabilities. You can type text into a window, set the color of the text's outlines and fill patterns, and then wrap the text around an object—a circle, perhaps—or get it to conform to a freehand curve. The package's Compound Objects feature lets objects in the background show through openings in foreground objects or in text.

Illustrator's method of coloring objects is disconcerting at times. It leaves messy black blobs composed of intermediate curves on the objects being colored. Fortunately, these blobs don't show up in the preview screen or on the printout. The package won't let you edit images in preview mode and also needs some sort of layering control to help organize and manage complex images.

The beta version of Adobe Illustrator 4.0 for Windows, which I recently got a glimpse of, promises to be as capable as its Mac counterpart and, thankfully, eliminates the preview editing flaw.

—T. T.



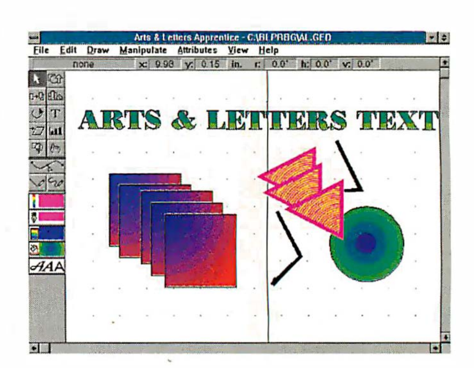
ALDUS FREEHAND 3.0

Aldus FreeHand 3.0, another object-based drawing package, is available in both Mac and Windows versions. FreeHand's strengths lie in its ability to organize your artwork's objects into layers and in its superb color-blending facility. Placing a blended color in an object is a simple matter of selecting the object and picking two colors and the fill direction. Furthermore, no black blobs appear after an object is filled, which makes it a snap to edit artwork.

A Layers palette enables you to design and manage very complex artwork. With it, you can create and name a layer, then selectively hide or reveal the objects that belong in that layer. This capability would prove useful if, for example, you were working on an aerospace drawing that required separate layers for the plane's fuselage and landing gear layer. Better still, you can edit the preview image.

Like Adobe Illustrator, Aldus FreeHand lets you wrap text around objects and curves and construct compound objects, which permits you to create special effects with text. FreeHand's big weakness is its interface: You sometimes must trek laboriously through menus and dialog boxes to set up the colors or color blends, and you must go through a dialog box to enter text into the artwork.

—T. T.



ARTS & LETTERS APPRENTICE 1.0

Arts & Letters Apprentice 1.0 is an object-based drawing program for Windows. The package includes over 3000 clip art images, 24 typefaces, tools for manipulating objects and creating charts, and a powerful mixing feature that can blend over 16 million colors.

The program's file-handling capabilities are average: You can export just seven graphic file formats and import five formats, including TIFF and PIC. GED, the program's native file format, is not a common one.

Another drawback is that, if you are working on a fairly large image, screen redraws are frequent and time-consuming on a 386 machine. Even when you close a dialog box, the graphics in your work space are refreshed, slowing any additional drawing and editing tasks.

If you need a virtually unlimited number of personally mixed colors, then Apprentice will serve you well. It offers three color-modeling methods: RGB, CMYK (cyan, magenta, yellow, black), and one based on hues. You combine colors by sliding a bar that controls the proportion of the mix; Apprentice immediately displays the resulting color on screen. Another very clever color mixing utility is Graduated Fill, which you can use to gradually change the color of an object—making it dark blue at the bottom and light blue at the top, for instance.

continued

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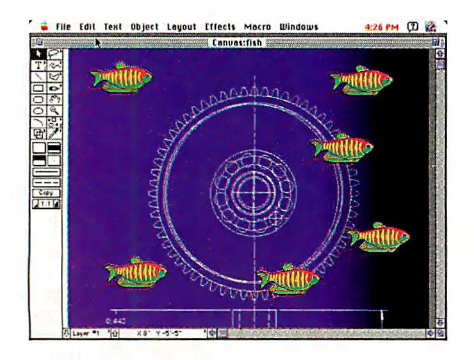


Circle 26 on Inquiry Card (RESELLERS: 27).



Arts & Letters Apprentice is a capable desktop graphics package and is a good choice if you are looking for a wide variety of prepackaged, high-quality clip art objects and symbols, powerful color mixing capabilities, and a charting tool.

—D. E.



CANVAS 3.0

Part drawing program, part painting program, Canvas has enough features to cover nearly any situation. The object-based tools in this $399 package are well suited to creating technical designs, such as architectural documents and engineering drawings that make heavy use of lines. Grids, alignment functions, Smart Mouse, and the Object Specifications dialog box (a CAD-like feature that positions an object according to user-defined constraints) help you place and modify a drawn object with precision. Canvas's Bézier curve-drawing tools are as good as any in the more expensive, PostScript-based programs.

But you also can paint away in free-form fashion. Tools for painting and editing bit-mapped images include the usual brushes, pattern buckets, spray can, and pencil (for freehand work). Canvas, which supports 32-bit color, treats whatever you paint as an object. After selecting an item you've painted, you can apply effects to it, move it around, and change its size.

Beginning with version 3.0, Canvas incorporates a number of impressive features for working with text. Not only can it fill a shape with text, wrap text around a shape, or superimpose text on a curve, the program can convert Adobe Type 1 and TrueType fonts into editable Bézier curves. Because Canvas 3.0 treats each text character as an object, you can modify text characters in just about any way you want—by scaling, slanting, stretching, and even coloring them.

Other highlights include support for System 7 and its Publish and Subscribe feature, the ability to produce color separations and slide-show presentations, and a comprehensive kit of special effects.

A program with 48 tools and dozens of customizable functions runs the risk of being overwhelming. Luckily, Canvas's developers have given users enough control that they can avoid too-many-things-on-the-screen syndrome.

With its extensive toolbox and wonderful flexibility, Canvas 3.0 is more than adequate for producing technical drawings, artistic illustrations, and textual graphics. Like the great DaVinci, this program is at home in the spheres of art, science, and business. If I could buy only one Mac graphics package, Canvas 3.0 would be the one.

—D. B.

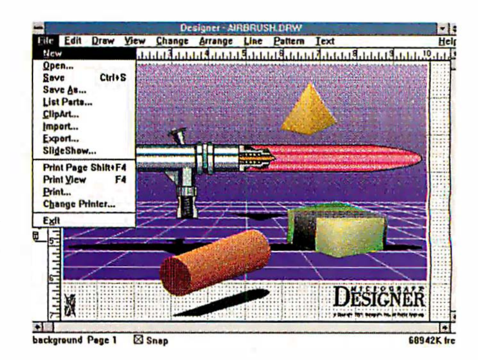
CORELDRAW 2.01L

Windows-based CorelDraw is a capable object-oriented drawing package endowed with both extensive drawing tools and good text-handling capabilities. Its Extrude feature, for instance, lets you reshape an object—allowing you to push a circle into a cylinder, for example, or blow up text to fill a balloon shape. CorelDraw also lets you superimpose one object on another and drop color blends into an object.

The package's excellent Align feature lets you line up objects by their sides or by their centers, which is handy for organizing complicated, overlapping objects. You can examine your results in a full-screen preview mode, or in a unique split-screen mode that presents the editing window along with the corresponding preview image.

But CorelDraw does have its faults. Like Adobe Illustrator, CorelDraw's blending feature leaves a huge mass of curves that get in the way whenever you try to modify artwork. And it lacks layering control and the ability to temporarily conceal objects. As a result, creating complex artwork can prove a daunting task. Finally, CorelDraw is slow. Running it on anything other than a fast 386- or 486-based computer with lots of RAM and a high-speed hard disk is torture.

—T. T.



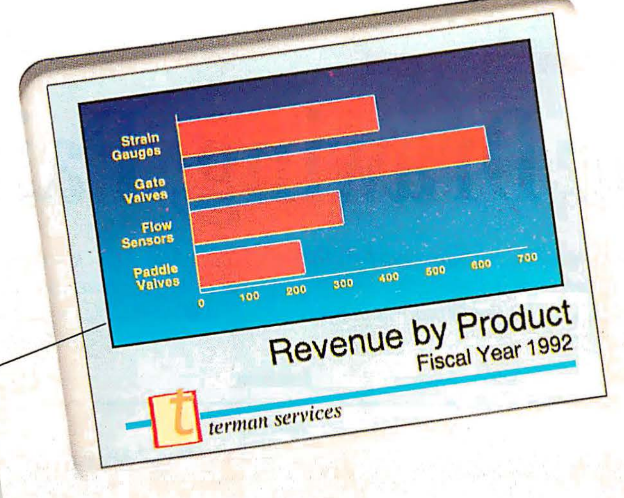
DESIGNER 3.1

Micrografx's competitor to CorelDraw, Designer 3.1, comes with a flexible set of drawing tools that makes the package a strong contender as a technical illustration package. The $695 Designer has numerous drawing tools for creating pie shapes, rectangles, lines, Bézier curves, arcs, and parabolas, as well as special tools for skewing objects, rotating text, or making text or other elements conform to curves. This abundance of tools makes Designer powerful, hard to learn, and sizable. Installing the complete program requires 10 MB of hard disk space.

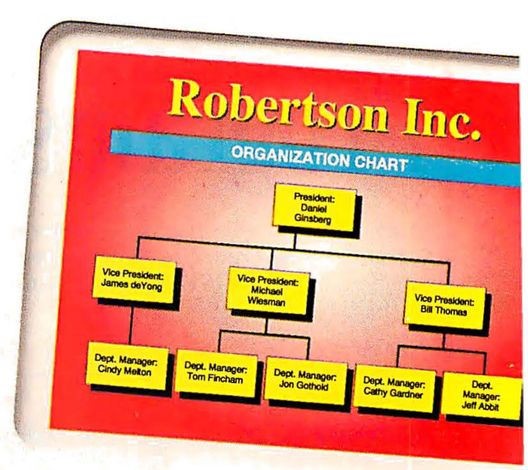
Designer is customizable, however. You can change or simplify the screen display, adding or removing tools in the toolbox. You can also customize the program's menuing system by adding fill patterns, colors, and other attributes to dialog boxes. In addition, Designer lets you create and edit drawings with as many as 64 layers, and edit drawings in either full-color or wire-frame modes.

To insert or edit text included in an illustration, you don't need a separate editing window. Designer permits you to apply typographic controls to individual characters or to blocks of text, and you can easily superimpose editable text on curves. You cannot, however, apply gradient fills to text objects without first converting them to curves. To vary the appearance of your text, you can use Bitstream- and URW-compatible fonts—or choose from among the 41 typefaces supplied with the program.

Designer doesn't skimp on color. It offers support for 256- and 24-bit color files and can accommodate video cards and monitors with resolutions as high as

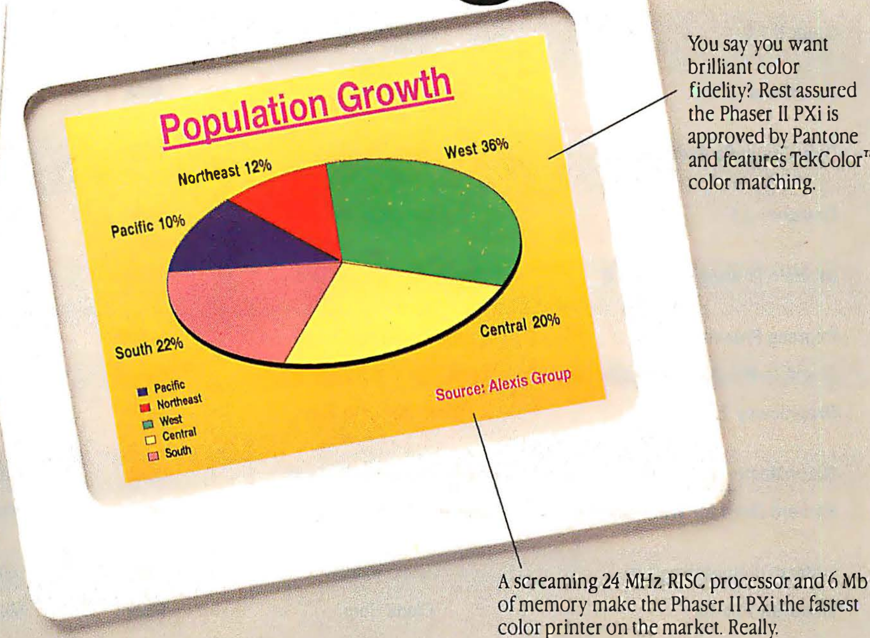


Not only is the Phaser™ II PXi the first thermal wax printer with Adobe's PostScript™ Language Level 2 software, it also has HP-GL. What more could you want from a printer?



Now make your ideas even brighter.





You say you want brilliant color fidelity? Rest assured the Phaser II PXi is approved by Pantone and features TekColor™ color matching.

A screaming 24 MHz RISC processor and 6 Mb of memory make the Phaser II PXi the fastest color printer on the market. Really.

So you have this great idea. One that'll win an account. Break a sales record. Or simply make you look like a genius. Don't blow it with a color printer that won't do your brainwork justice.

Get the new Phaser II PXi, a thermal wax printer that works simultaneously with Macs, PCs and workstations. It can generate 16.7 million colors at 300 dpi, and it's cost-effective.

To see the quality of its output first hand, call **1-800-835-6100, Dept. 16J** and we'll send you a free sample.

The new Phaser II PXi. It'll make your ideas look as bright as they should.

Tektronix
The best and the brightest.

Circle 25 on Inquiry Card.

Programs for Drawing, Painting,

Many of the graphics packages import and export a bewildering variety of graphics file formats. Check which file formats you normally use before selecting a package. The maximum colors a package can display are limited by the available hardware for DOS computers and the Macintosh, and by the Windows configuration. (● = yes; ○ = no)

Product	Company	Price	Platform	Import Files
ABC Flowcharter 1.13	Roykore, Inc.	$296	Windows	None
AccuDraw for WordPerfect 2.1	AccuSoft Corp.	$195	DOS	WPG, CGM, PIC, DXF, GEM CUT, IMG, HPGL, PCX, TIFF
Adobe Illustrator 3.0.1	Adobe Systems, Inc.	$595	Macintosh	Illustrator 88/1.1, EPSF
Aldus FreeHand 3.0	Aldus Corp.	$595	Macintosh	EPS, PICT, TIFF
Aldus FreeHand 3.0	Aldus Corp.	$595	Windows	EPS, AI, BMP, CGM, DRW, GRF HPGL, PCX, PIC, PLT, PNT, XLC
Arts & Letters Apprentice 1.0	Computer Support Corp.	$169	Windows	TIFF, WMF, PIC, DIA, ASCII
CA-Cricket Graph 1.3.1	Computer Assoc. International, Inc.	$129	Windows	ASCII, DIF, SYLK, WK1, WK2, WK3 Cricket Graph for Mac
CA-Cricket Graph 1.3.2	Computer Assoc. International, Inc.	$129	Macintosh	ASCII, DIF, PICT, JWKS, SYLK WK1, WK2, WK3, WKS
Canvas 3.0	Deneba Software	$399	Macintosh	CGM, DXF, EPSF, IGES, PICT, TIFF, MacPaint, Illustrator 88/1.1, Ultrapaint
Color It 1.0	MicroFrontier	$119.95	Macintosh	GIFF, TIFF, PICT, MacPaint, Photoshop
CorelDraw 2.01L	Corel Systems Corp.	$695	Windows	BMP, CGM, DXF, EPS, GEM, PCX PCT, PIF, HPGL, PIC, PICT, TIFF
DeltaGraph Professional 2.0	DeltaPoint	$295	Macintosh	WKS, Excel, SYLK, ASCII, PICT, EPSF, Cricket Graph, Trapeze, QuickTime Movie
Designer 3.1	Micrografx, Inc.	$695	Windows	MGX_DRAW, MGX_PICT, PICT BMP, SYLK, ASCII
Dr. Halo IV Imaging Pak 1.0	Media Cybernetics, Inc.	$140	DOS	TIFF, TGA, PCX, IMG, HALO CUT
Express Presenter 1.0	Power Up Software Corp.	$199.95	DOS	ASCII, CGM, PIC, TIFF, WK1, WKS
Graph-in-the-Box Executive 1.14	New England Software, Inc.	$299.95	DOS	DIF, CGM, HPGL, EPS, PIC
Graphicway 1.0	Tilcon Software, Ltd.	$495	Windows	PCX, TIFF, WKS, DBF, DIF ASCII, RIPCAM
GraphMaster 1.31	Visual Business Systems	$295	Macintosh	WKS, Excel, SYLK, ASC, EPSF, PICT
Harvard Draw for Windows 1.0	Software Publishing Corp.	$595	Windows	CHT, SYM, DRW, EPS, CH3, SY3, DXF CGM, AI, WMF, BMP, PCX, TIFF
Instant ORGcharting 1.0	Roykore, Inc.	$195	Windows	ASCII, WMF
MacDraw Pro 1.0	Claris Corp.	$399	Macintosh	EPSF, TIFF, ASCII, PICT, MacDraw
Mass-11 Draw 6.1	Microsystems Engineering Corp.	$695	DOS	PIC, Mac PICT, CGM, HPGL, MDL, TEK
Michael's Draw 1.0	Event One	$149	Macintosh	EPSF, PICT, MacPaint
Painter 1.0	Fractal Design	$299	Macintosh	PICT, RIFF, TIFF, Photoshop
Painter 1.0	Fractal Design	$299	Windows	PICT, RIFF,TIFF,Photoshop
PC Paintbrush IV Plus 2.0	ZSoft, Inc.	$240	DOS	PCX, TIFF
Publisher's Paintbrush 2.0	ZSoft, Inc.	$495	Windows	BMP, GIF, MSP, PCX RAW, TGA, TIFF
Splash	Spinnaker Software Corp.	$39.95	DOS	TIFF
Windows Draw 3.0	Micrografx, Inc.	$149.95	Windows	DRW, GRF, PCX, PIC, TIFF ASCII, WMF, AI, EPS, CGM GEM, Mac PICT, WPG

Charting, and Graphing

Export Files	Maximum Colors	Maximum Fonts	Undo Command	Rotate/ Flip	Color Separation	Video Support	Output Devices
WME	Windows	Windows	●	○	○	Windows	Win
PNTG, PPIC, DXF, MSP CUT, IMG, HPGL, PCX, TIFF	16	3	●	●	○	Super VGA	Only through WordPerfect
Illustrator 88/1.1, EPSF	16.7 million	Macintosh	●	●	○	Macintosh	Mac, PostScript
EPS, PICT, TIFF	Macintosh	Macintosh	●	●	●	Macintosh	Mac
EPS, AI, BMP, CGM, DRW, GRF HPGL, PCX, PIC, PLT, PNT, XLC	Windows	Windows	●	●	●	Windows	Win
EPS, CGM, TIFF, SCD, WMF, WPG, CSP	Windows	Windows	●	●	○	Windows	Win
ASCII, DIF, SYLK, WK1, WK2, WK3, Cricket Graph for Mac	Windows	Windows	○	○	○	Windows	Win
ASCII, DIF, PICT, JWKS, SYLK WK1, WK2, WK3, WKS	Macintosh	Macintosh	●	○	○	Macintosh	Mac, slide service
CGM, DXF, EPSF, IGES, PICT, TIFF, MacPaint, Illustrator 88/1.1, Ultrapaint	Macintosh	Macintosh	●	●	●	Macintosh	Mac, PostScript
GIFF, TIFF, PICT, MacPaint, Photoshop	Macintosh	Macintosh	●	●	○	Macintosh	Mac, Postscript
BMP, CGM, DXF, EPS, GEM, PCX PCT, PIF, HPGL, PIC, PICT, TIFF	Windows	Windows	●	●	●	Windows	Win
PICT, EPSF, ASCII, Illustrator 88/1.1	Macintosh	Macintosh	●	●	○	Macintosh	Mac, PostScript, film recorder
DRW, TIFF, CGM, WMF, DXF, GEM HPGL, PCX, EPS, PICT1&2	Windows	41	●	●	○	Windows (Super VGA)	Win
TIFF, TGA, PCX, IMG Halo CUT, MSP, BMP	16.7 million	45	●	●	○	Super VGA	Color/B&W printers
ASCII, CGM, PIC, TIFF, WK1, WKS	256	16	●	○	○	Super VGA	Color/B&W printers
DIF, CGM, HPGL, EPS, PIC	15	10	●	●	○	VGA	Color/B&W printers, plotters
PCX, TIFF, HPGL, EPS, WKS DBF, DIF, ASCII, RIPCAM	256	18	●	●	○	Windows	Win
ASCII, SYLK, PICT, Illustrator 88/1.1	Macintosh	Macintosh	●	●	○	Macintosh	Mac
EPS, CH3, SY3, DXF, CGM, AI, WMF BMP, PCX, TIFF, PIC, SCD, LL	Windows	Windows	●	●	○	Windows, TIGA	Win, film recorders
ASCII, WMF	Windows	Windows	●	○	○	Windows	Win
EPSF, PICT	Macintosh	Macintosh	●	●	○	Macintosh	Mac, PostScript Film recorders
DRW, CGM, ILF	3.6 million	2	●	●	○	Super VGA	Printers, plotters, film recorders
EPSF, PICT	Macintosh	Macintosh	●	●	○	Macintosh	Mac, PostScript
PICT, RIFF, TIFF, Photoshop	Macintosh	Macintosh	●	○	○	Macintosh	Mac, PostScript
PICT, RIFF, TIFF, Photoshop	Windows	Windows	●	○	○	Windows	Win, PostScript
PCX, TIFF	256	25	●	●	○	VGA	Color/B&W printers, plotters
PCX, BMP, EPS GIFF, TGA, TIFF	Windows	15	●	●	○	Windows	Win
TIFF	256	13	●	●	○	VGA	Color/B&W printers
DRW, EPS, HPGL, PCX, PIC PS, TIFF, WMF, AI, CGM GEM, Mac PICT, WPG	Windows	Windows	●	●	○	Windows	Win

LARGER DISPLAY AREA FOR BIGGER IMAGES



BRIGHTER SCREENS FOR SHARP, CRISP IMAGES

NON-INTERLACED, FLICKER-FREE DISPLAY FOR LESS EYE STRAIN

WISHES DO COME TRUE. And at MAG Innovision™ our new MX-Series color monitors are making a number of wishes come true. These advanced displays are great for all types of applications, particularly Microsoft® Windows.

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LARGER DISPLAY AREA. Every MX-Series monitor uses advanced overscan technology to provide an edge-to-edge active display area that dwarfs displays of comparable size by as much as 36 percent!

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PC MAGAZINE EDITORS' CHOICE

BUILT-IN MICROPROCESSOR. Each MX-Series display has its own microprocessor that can adjust the display format automatically to work with almost any of the available video standards. So whether you're

BUILT-IN MICROPROCESSOR FOR AUTOMATIC CONFIGURATION

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INTRODUCING THE ULTIMATE WINDOWS DISPLAYS.

HIGH-RESOLUTION FOR MORE WORK SPACE



changing a video mode or upgrading a video card, the MX display will adjust automatically. And, if you do make adjustments, you only do it once. An MX display never forgets.

SHARPER, BRIGHTER IMAGES. By incorporating an Invar Shadow Mask into the MX15F and MX17F, we've achieved 30 percent more brightness without sacrificing sharp, crisp focus. And when combined with our high-resolution and fast-refresh rate, that 30 percent more brightness truly creates an image to wish for.

LISTEN TO THE EXPERTS. Don't just take our word for it. We're partial. Read *PC Magazine*'s "Editors' Choice" for July 1991. They said of the MX15F..."clearly the best." Or listen to *PC World* (12/91) rave about the MX17F... "so great that it defies comparison."

WISHES DO COME TRUE. The next time you go window shopping to look at Windows displays check out an MX monitor. For more information on how to make your wishes come true, call us now at 1-800/827-3998, or contact us at our corporate headquarters: 4392 Corporate Center Drive, Los Alamitos, CA 90720. Tel: 714/827-3998. Fax: 714/827 5522.

MAG INNOVISION

Circle 30 on Inquiry Card (RESELLERS: 31).

A Comparison of Capabilities

Painting and drawing features: All of the graphics packages we looked at had basic tools for image manipulation. Advanced or user customizable tools, such as customizable patterns or modifiable brushes, can give you more professional-looking results. Charting and graphing features: The larger the number of data points and data sets a package can handle, the greater the detail a chart or graph can display. (● = yes; ○ = no; N/A = not applicable.)

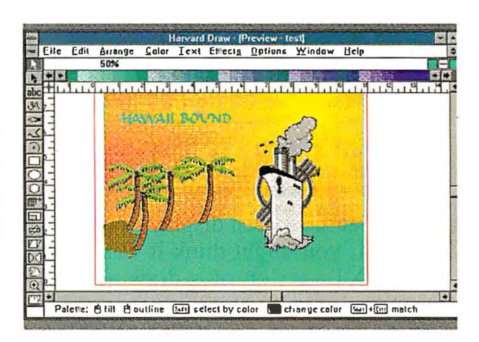
	PAINTING AND DRAWING FEATURES							
	Skew	Resize	Gradient Fill	Customizable Patterns	Masking	Modify Brushes	Group/ Ungroup	Graph Types
ABC Flowcharter 1.13								Organization
AccuDraw For Word Perfect 2.1	○	●	○	○	○	○	●	
Adobe Illustrator 3.0.1	●	●	Via Blend tool	●	●	○	●	6
Aldus FreeHand 3.0 (Mac)	●	●	●	●	●	○	●	
Aldus FreeHand 3.0 (Windows)	●	●	●	●	●	○	●	
Arts & Letters Apprentice 1.0	●	●	●	●	○	○	●	5
CA-Cricket Graph 1.3.1								9
CA-Cricket Graph 1.3.2								10
Canvas 3.0	●	●	●	●	○	●	●	
Color It 1.0	●	●	●	●	●	●	○	
CorelDraw 2.01L	●	●	Via Blend tool	●	●	○	●	
DeltaGraph Professional 2.0								17
Designer 3.1								
Dr. Halo IV Imaging Pak 1.0	●	●	●	●	○	●	○	
Express Presenter 1.0								11
Graph-in-the-Box Executive 1.14								12
Graphicway 1.0	●	●	●	●	○	○	●	7
GraphMaster 1.31								13
Harvard Draw for Windows 1.0	●	●	●	●	○	○	●	
Instant ORGcharting 1.0								Organization
MacDraw Pro 1.0	●	●	●	●	○	○	●	
Mass-11 Draw 6.1	●	●	○	●	○	○	●	
Michael's Draw	●	●	●	●	●	○	●	
Painter 1.0 (Mac)	○	○	○	○	●	●	○	
Painter 1.0 (Windows)	○	○	○	○	●	●	○	
PC Paintbrush IV Plus 2.0	○	○	●	●	○	●	●	
Publisher's Paintbrush 2.0								
Splash	○	○	●	○	○	○	○	
Windows Draw 3.0	●	●	●	●	○	○	●	

CHARTING AND GRAPHING FEATURES

Cut/ Paste	Freehand Drawing	Maximum Data Points	Maximum Data Sets	Edit Text	Edit Legends	Math Coprocessor Support
	N/A	N/A	●	●	○	
●	●					●
●	○	N/A	1	●	○	Via SANE
●	●	60	5	●	●	○
●	○	108,000	216,000	●	●	○
●	○	270,000	540,000	●	●	○
●	●	10,000	unlimited	●	●	Via SANE
●	●	270	1440	●	●	○
○	○	1000	1	○	○	○
●	●	2200	12	○	●	○
●	●	10,000	unlimited	●	●	Via SANE
●	●					●
●	○	N/A	N/A	●	●	○
●	●					
●				●		
●	●					●

Super VGA resolution. Micrografx Designer is well suited to handling complex technical drawing and sophisticated images. With its multitude of special-purpose tools, Designer is difficult to learn, but it is a powerful illustration package.

—S. W.



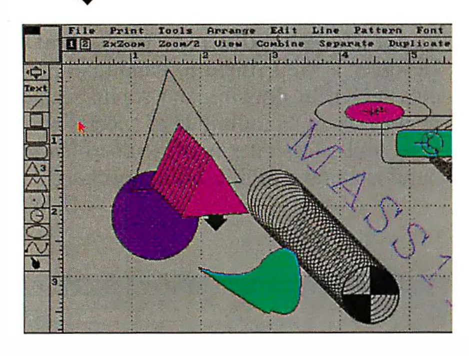
HARVARD DRAW FOR WINDOWS 1.0

Software Publishing's Harvard Draw for Windows is an object-oriented program that gives you a snappy drawing interface with 18 speedy drawing tools. Its support for as many as 99 layers within each illustration (think of each layer as a separate sheet of acetate) makes this a drawing and painting package for the professional artist.

You can work in multiple windows, creating, previewing, and editing full-color images. The package offers 16.7 million user-defined colors with 12 predesigned palettes of 150 colors each, as well as user-defined palettes. Equally important, you can undo up to 16 actions in a row, blend objects, make multiple copies of an object, and cut holes in objects. The program can import and export a wide range of vector and bit-mapped file types. You can call up clip art files and symbols into separate windows, using a thumbnail image to preview them before you go further.

Harvard Draw for Windows takes much of the guesswork out of moving objects. As you move your mouse, a black-and-white outline of the object shows its exact position on-screen. The original color object remains in place until you release the mouse button. Unfortunately, though, every time you move or modify an object, the screen must repaint itself. This is slow on a 386 machine, even for simple images. Be prepared to spend at least an hour loading the 12 program disks onto your hard drive.

—D. E.



MASS-11 DRAW 6.1

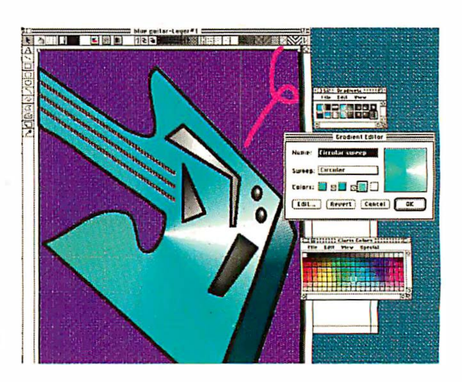
Looking at the screen display of Mass-11 Draw 6.1, you might think it was a low-end PC/XT version of a drawing package, but don't let this less-than-pretty picture deceive you. DOS-based Mass-11 Draw actually has enough sophisticated features to interest users who want to create engineering and technical illustrations without investing in a more expensive CAD application.

Mass-11 Draw provides a spline curve tool with several interactive drawing methods, as well as a utility called Tracer for converting scanned TIFF images, paint program images, or bit-mapped images into a drawing file that you then can edit and scale. Drawbridge, an on-board TSR graphic file-translation utility, can handle HPGL, PICT, MDL, and PIC files. Mass-11 Draw lets you use a digitizing tablet to trace artwork for input into the program and reportedly will display the tracing to an accuracy of 0.002 inch. The package includes libraries of clip art and symbols.

A few of the program's features are somewhat unwieldy, however. When you cut and paste objects, they end up positioned in the *center* of the screen—whether or not that's where you want them. And rotating an object to any angle other than 90 degrees or 180 degrees skews the object.

If you need a good library of prepackaged technical clip art and symbols, and a powerful tool for drawing spline curves as well as other basic drawing tools, then Mass-11 Draw will get the job done.

—D. E.



MACDRAW PRO 1.0

In the process of acquiring Pro status, object-based MacDraw Pro has become proficient at handling color, curves, and text. It has the curve-wrangling functions found in PostScript packages such as Aldus FreeHand and Adobe Illustrator. The Bezigon tool—as in *Bézier* and *polygon*—lets you map out a curve by placing points on the page with mouse clicks rather than by pulling on handles as you would with Adobe Illustrator or Aldus FreeHand. If you're one of the humble mortals frustrated by the usual Bézier methodology, you might find this connect-the-dot procedure more to your liking. And if you want to go back and edit a shape, you just pull on a dot or control point, dragging the line where you want the curve to pass.

Not only does it support 24-bit color, MacDraw Pro has good color-mixing capabilities and lets you set up custom, tear-off color palettes. For shading objects, the package provides a palette of 16 preset gradients (directional, circular, or shape burst) or you may easily develop new ones with the program's nicely implemented editor.

The package has the usual pens and tools for generating geometric shapes (e.g., rectangles, ovals, and arcs), as well as a freehand drawing tool. You create text just as you would an object. That means you can apply colors and fill patterns to characters, but you cannot automatically fit text inside a shape or make it conform to a curve. Oddly, System 7 functions are scarce: TrueType support, virtual memory, and the use of aliases.

MacDraw Pro will never get pulled over by the Highway Patrol; gradient fills are especially time-consuming. Even on a Mac II hopped up with a Radius Rocket, a circular fill took 15 to 20 seconds. While color manipulations can tax any system, this program is noticeably slow. Claris itself has acknowledged as much, promising speed

Rasters and Vectors

Computer graphics has evolved into a jungle of file types with no overall standard for what format images are saved in. The methods for creating images, however, fall into just two major classes: vector and raster. Each has special advantages.

Paint packages create raster, or bit-mapped, files by using hardware to define the grid of dots that compose an image. Each dot has a specific color. One big advantage of bit maps is that you can edit each pixel in the array of dots. And because you can manipulate these dots, you can mix them the way an artist might mix paints on a canvas. Developers have learned to do wonders with the bit-mapping concept: Witness the new programs that come close to electronically simulating the properties of real paint. The resolution of these device-dependent image files is limited to that of the display used to create them, and the resolution of the output device determines the final quality of the image.

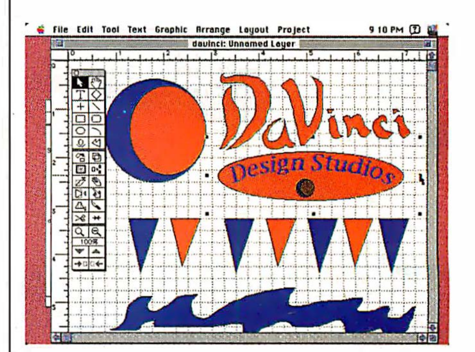
Vector files are used by programs that generate line-oriented art; CAD packages and technical illustration products typically fall in this category. Vector files are object-oriented and, as such, are composed of a series of instructions—for point-to-point lines or circles, for example—that are placed at specific positions. A shape, pattern, or shading is described by a formula or code and assembled into lists of geometrical abstractions. Vector graphics are device-independent. Object-oriented graphics can be scaled without distortion and can be printed at the highest resolution of the output device. Their object orientation makes vector programs ideal for the precision drawing needed by engineers, architects, designers, and others working on the geometric planes.

fixes in an upgrade already in the works.

For the person just getting into computer graphics, MacDraw Pro is a good choice. It's easy to learn and use and you can get sharp results without hauling yourself up the steep learning curve of a PostScript package. But before you join on, be aware that you'll need at least 4 MB of memory to burn—and a fairly stout Mac.

For users who need to produce professional-looking images but have little artistic ability, MacDraw Pro provides a strong alternative to Adobe Illustrator and Aldus FreeHand.

—D. B.



MICHAEL'S DRAW 1.0

Michael's Draw, an object-based drawing program with an unusual name, is a straightforward package for generating line-oriented artwork and twiddling text with special effects. The package has the standard tools for drawing geometric shapes, polygons, and lines. A nice complement of reshaping functions let you skew objects, shear them, and add perspective. A handy Copy tool automatically replicates a selected object, which can save you repeated trips to the copy/paste menu while you're attempting to clone a particular element.

To create complex drawings, the program relies on layering and "script" commands. The procedure, which involves creating scripted images by compiling a montage of layers into a single picture, requires careful reading of the manual.

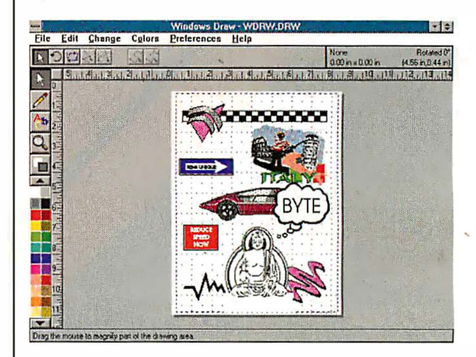
The program also offers a considerable number of tools for manipulating text. It's easy to wrap text around a shape, have it follow the curve of a line, or flow a block of type into a particular shape. You can add color to text and achieve smooth gradations of color between the first and last letters. Although not as sophisticated as most desktop publishing programs, Michael's Draw has good typographic controls. A well-designed

dialog box makes it easy to adjust the spacing between characters.

In keeping with its individualistic moniker, Michael's Draw has an individualistic interface. That interface is intuitive enough, but it sometimes departs from the conventions of other Mac drawing programs. The differences are subtle—the use of heavy frames around selected items, for example—but getting used to the program's look and feel can take a while.

This is a capable package that's more than adequate for producing heavily geometric designs and generating text with special effects. Even though Michael's Draw doesn't really do anything unique, it's fairly priced, isn't a resource hog, and is easy to learn and use.

—D. B.



WINDOWS DRAW 1.0

Micrografx Designer has received most of the attention, but the company's low-end drawing program, Windows Draw, has a number of fine qualities: It is intuitive, easy to use, and smart. This Windows-based package comes with more than 2600 vector-based clip art images, which you can reshape, customize, move, and rotate with ease.

Running in 24-bit color graphics mode, Windows Draw offers 16 million colors, from which you may select a 64-color palette. You can create your own bit-mapped fill pattern by editing magnified pixels; your editing changes are visible on-screen immediately.

The rotation tool is ingenious. You establish a focal point for the rotation by positioning the cursor near the object and clicking; then you use the mouse to rotate the cursor—left or right—until the object is in the correct position. Special effects include slanting, color blending, stretching, and the ability to wrap text around objects and apply custom gradient styles.

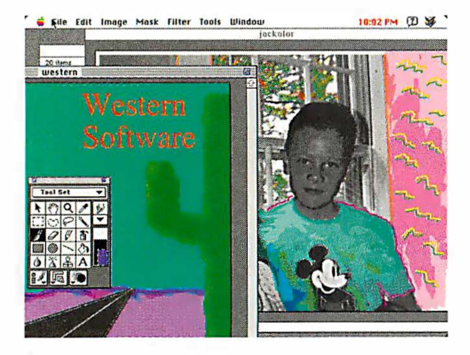
To know instantly the function of each icon or to name a color, you simply

point to it with the mouse; a hint line at the bottom of the screen provides information about the item in question. The documentation for Windows Draw is excellent, and its pictorial index of all clip art names is especially helpful. In short, this $149.95 package is a superb value.

—D. E.

PAINTING

Software has come a long way since the dawn of MacPaint, which truly was a marvel in its day. Not only can paint packages now take advantage of 16 million colors, far more than most anyone needs, these days some of them work more like traditional artistic tools. Creative designers who thus far have resisted doing graphics on personal computers are being won over by the power of these programs, especially once they realize they can save time and money by working in an electronic medium. If your business graphics requirements involve colorful, fluid designs that aren't limited to the rules of geometry, you'll be well served by one of the following paint programs.



COLOR IT 1.0

This bargain-priced 24-bit color paint program will appeal to anyone who likes the feel of working with watercolors. With its brush-control functions and ability to fine-tune the opacity of paint, Color It closely simulates the feel of working with traditional media. With the right adjustments, the tools take on a watery, fluid feel.

You can also lay color on thick, but one of the program's most appealing aspects is its ability to go lightly. With the nifty Smudge tool, you can easily blend the colors in a picture (imagine running your finger through wet paint). Sharpen and Blur let you harden or soften the edges of an image.

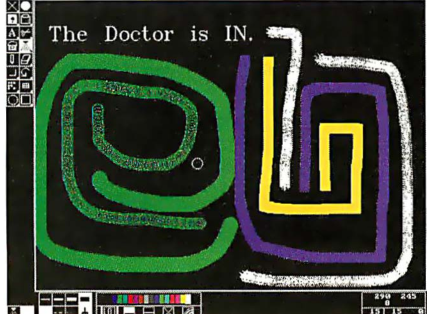
The various color palettes let you choose from the usual grid of 16 pigments and 256 gray scales, or from a color wheel. You can also set up your own customized palettes. The pattern set, to which you can add patterns of your own making, includes some designs not found in other Mac painting programs—among them, ack!, an array of yellow happy faces.

Color It is more than a program for painting original graphics. It's also nicely equipped for editing scanned images, which you then can place in a desktop-published document, for example. It isn't quite Adobe's PhotoShop, but the program has more than adequate tools for fixing up images, including brightness and contrast adjusters, edge sharpeners, and other filters and special effects. Despite its name, Color It is a fine gray-scale editor, too.

I found two things I could do without, however: an odd gradient-fill tool that kept filling the entire work area instead of the selected object and a delete function that wiped the entire image off the screen (praise be the undo function).

In some ways, this is more of a free-form artist's package than a corporate graphics program. But with its capabilities for enhancing scanned images, Color It provides editing and colorizing functions that will appeal to the business artist who wants to add zing to documents and brochures. Best of all, the package is priced at $119.95, proof that really slick software doesn't have to cost a lot. Truly a remarkable deal.

—D. B.



DR. HALO IV IMAGING PAK 1.0

Media Cybernetics' paint and graphic editing package, Dr. Halo IV Imaging Pak comprises six distinct modules: drawing program, viewer, presentation program, TSR screen grabber program, font editor, and image-conversion utility. But the program is showing its age; it isn't as well integrated as many comparable programs. Singly, the utilities are quite powerful, but the package lacks a unified menu structure, so you must run each utility program separately.

Dr. Halo IV's drawing tools are easy to use, but the screen icons are small and cryptic. And although you can easily position text in any image, the program doesn't provide a text editor. Worthwhile features include unique tools that let you create sunburst effects with all the colors in the screen palette and a very handy TSR screen grabber. The program also is versatile enough to let you capture a DOS screen from within almost any application and save it as a TIFF or PCX file.

Despite shortcomings, this $140 package is adequate for doing basic freehand drawing and editing graphics. A complete installation requires 3.7 MB of disk space.

—S. W.

GRAPHICWAY 1.0

Graphicway is a Windows-based program that's one-half drawing and one-half charting package. All the standard paint, drawing, graphing, and presentation tools are included, and the components are well integrated. Every tool and function is available from the icon display and from the menus.

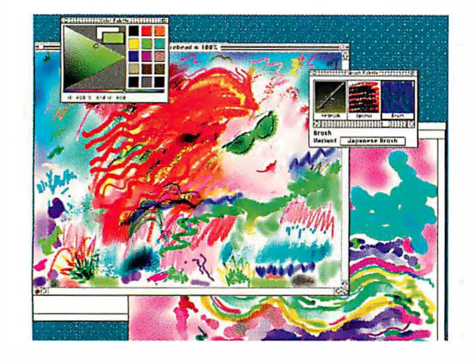
An extensive clip art library also comes in the package; in it, you'll find library subdirectories for architecture, geography, graphic elements such as geometric shapes, and backgrounds, food and animals, signs, and symbols—including many for electronic schematics. Much of the clip art is rather simple, which makes it perfect for slide presentations and charts. But the package also contains many examples of animated art.

Graphicway's file handling is very good. It's easy to select and display directories, and you can call up a preview window for viewing images prior to editing them. Installation is simple; the package even creates its own group under Windows. A complete installation requires 8.2 MB of disk space. Tilcom Software sells several versions of the product: a run-time version is $149, a presentation version that includes provision for creating slide shows is $495, and a developer version is $695.

Graphicway is a complete business package that tries to do it all.

—S. W.





PAINTER 1.0

Working with this amazing paint program for the Mac and Windows seems almost like working with the real thing. Fractal Design has developed software that comes close to replicating the feel of working with a variety of traditional artistic media. The toolbox includes everything you'd find in a well-equipped studio: a selection of brushes, colored pencils, chalks, charcoals, calligraphy pens, felt-tipped pens, crayons, and an airbrush.

More significant, the tools generally work the way their nonelectronic counterparts do. If you take the pencil, say, and make a quick stroke, you get a light line on the screen. Bear down on a pastel chalk, and you get a broad smudge. Rub a yellow felt tip pen against black ink and the yellow gets "dirty." Each tool can be adjusted to provide different effects. You can dilute colors or blur an image by dropping "water" on it. This 24-bit paint program employs the HSV (hue, saturation, value) color system and an easy-to-use color wheel for choosing colors. As you apply more color to a region, it gets darker and denser—exactly what you'd expect in real life. Because their tools are pressure sensitive, both versions of Painter are best used with a pen and tablet (I used a Wacom digitizer). You can use a mouse, but drawing with a brick doesn't do this package justice.

The work space allows you to simulate painting or drawing on different types of paper and illustration board, offering you a wide range of grains and textures from which to choose. The paper you select determines, for instance, how a brush or other tool lays down paint or ink.

The tools are all reasonably responsive, particularly if you've got an accelerated Mac. Sometimes, though, you can end up a few steps ahead of the screen; even on a Mac with a Radius Rocket, the screen was a few seconds behind what I was doing on the tablet. The package doesn't include tools for altering the appearance of text.

You have to work with Painter to really appreciate it. Although it's geared toward experienced artists, even people who haven't picked up a paintbrush since grade school are impressed by the way it simulates traditional tools. Businesses that want unique, eye-catching graphics ought to put this in the hands of their designers. But beware: Productivity might drop, as users are inclined to get caught up exploring this remarkable electronic art studio. At $299, it's worth every penny. Painter is too cool for words.

—D. B.



PC PAINTBRUSH IV PLUS 2.0

DOS-based PC Paintbrush IV Plus, the latest version of an old standard, is a painting and image-editing program. The $240 package can work with both PCX and TIFF files and supports 8-bit color images.

PC Paintbrush's principal strength is image enhancement. It provides seven special-effects tools that control blending, smudging, gradient fill, tiling, tinting, brightness and contrast. These tools can be used to change all or part of a graphic image, and you may enhance an image using outlining and shadowing. Or you may reduce a graphic element by as much as 25 percent or enlarge it by as much as 400 percent. PC Paintbrush's repertoire also includes the ability to overlay images and the ability to zoom in and out to provide detailed editing of graphic elements.

PC Paintbrush is optimized for use with a long list of scanners, both stand-alone and hand-held. You can control a scanner from the file menu and capture black-and-white or color images. The scanner setup options include settings for brightness, contrast, image type, resolution, and scaling. The program defaults to a 4- by 4-inch size, but you can enlarge or reduce this. Unfortunately, it is very difficult to paste two images together if you have to use multiple scans of a large image.

This a good, basic picture-editing program. But its limitations are evident when compared to one of the newer Windows packages, such as ZSoft's own PhotoFinish. Still, PC Paintbrush IV Plus is easy to use, and if you follow the tutorial, you'll be drawing and painting in no time.

—S. W.

PUBLISHER'S PAINTBRUSH 2.0

Publisher's Paintbrush 2.0, ZSoft's Windows-based big brother to PC Paintbrush IV Plus, is an expanded painting and image-editing package. This $495 update now supports 24-bit color files and can display 256 shades of gray and 16.7 million colors. Version 2.0 supports a variety of scanners as well as several devices used for color calibration.

The package makes more intelligent use of Windows than did previous versions. By supporting the Multiple Document Interface, the program lets you open multiple graphic-image files and reduce them to icons when you don't need them open on-screen. The initial screen display shows a toolbox of 42 tools, which may be grouped into 24 primary icons with pull-down secondary icons. You can rearrange the location of the tools on the screen to suit your needs. If you think the brush width and color palettes take too much screen space, you may move, fold, or hide them. If you have a particular set of tools you prefer to work with, you can save that combination of tools as a personal workspace.

The package's standard drawing tools are extremely powerful. ZSoft supports both its own proprietary fonts and URW outlines. You can enter and edit text in a dialog box. Publisher's Paintbrush has very strong import/export capabilities, but it relies heavily on the older 8-bit PCX format.

Publishers Paintbrush also is optimized for use with scanners. It is compatible with a long list of scanners, both stand-alone and hand-held models. A complete installation requires 7 MB of hard disk space. Publisher's Paintbrush provides advanced graphic image editing capabilities for PC users running Windows.

—S.W.

SPLASH

Splash from Spinnaker Software is small, quick, inexpensive, useful, and a delight to use. Although definitely not a

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high-powered graphics program, this VGA-only package is just right for touching up and annotating TIFF files from other programs.

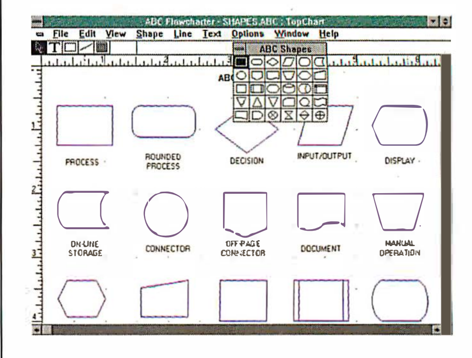
Useful features include an easily changeable 256-color palette and the ability to digitize signals from a Digital Vision ComputerEyes video digitizer. Shortcomings include a user interface that beeps when you perform a function properly and a limited zoom capability. The zoom function has only two sizes: normal and zoomed. When you zoom in, you get a close-up look at a portion of the larger image.

If you are on a tight budget, don't do a lot of drawing, or have children who like to draw, Splash is well worth exploring. The $39.95 price simply cannot be beat.

—R. C.

CHARTING AND GRAPHING

Charts and graphs are the mainstays of business graphics. Any serious enterprise needs to produce them at some time, for use in annual reports, business plans, promotional materials, internal financial documents, and presentations. Although many of the popular spreadsheet programs are quite astute at generating good-looking graphs, sometimes the situation calls for something more sophisticated or more creative. Also, not everyone is a spreadsheet user. Whether you need to generate charts and graphs from raw data or from cells imported from a spreadsheet package, there's a wide choice of programs that can make your visual information look professional and appealing. Mac users have an advantage here in that the better charting tools currently run on that machine. Obviously, the Mac has become a serious business computer.



ABC FLOWCHARTER 1.13

As a Windows-based diagramming and charting program, Roykore's ABC Flowcharter provides a means of tracking procedural flow. The program's ability to link charts with chart shapes lets you create complex, hierarchical flowcharts, which you navigate by double-clicking on a chart icon and displaying the linked chart. A unique navigational grid above the vertical scroll bar moves the window image in each of the compass directions.

Flowcharter takes advantage of the Windows environment by providing complete control of most display options. You can control color, line width and style, shadowing, fill colors and patterns, and text format. The program's Fit Shape feature automatically adjusts the symbol size to display all the text. Unfortunately, the text is not contoured to the symbol shape, and text does not fit well within nonrectangular symbols. Circles and triangles, for instance, often are displayed with text extending beyond the borders.

Since Flowcharter supports Windows 2.11 as well as 3.0, it does not use the

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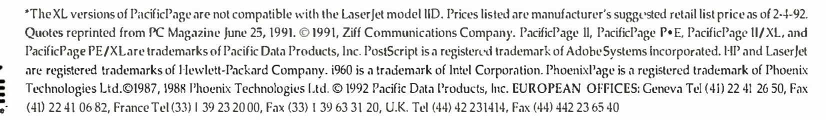
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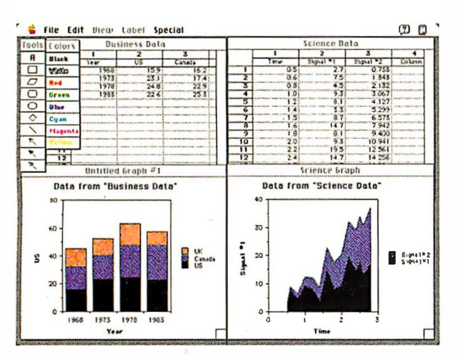




standard Windows help interface. The custom help interface is confusing because the index is arranged in topical rather than alphabetical order. Looking for answers to a particular question requires a lot of manual scanning. Another significant drawback is that, when I ran it in 1024 by 768 graphics mode, Flowcharter repeatedly lost pieces of symbols. The edges of the symbols weren't always drawn. This problem did not appear in standard 640 by 480 graphics mode.

Except for the improperly drawn symbols, the $295 ABC Flowcharter performed smoothly and well. It felt comfortable to use and interaction was intuitive.

—R.C.



CA-CRICKET GRAPH

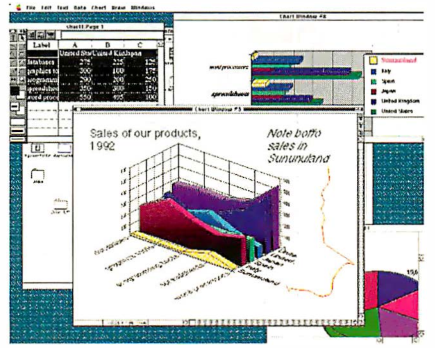
CA-Cricket Graph from Computer Associates International is a chart-creation and presentation package for both Microsoft Windows and the Macintosh (versions 1.3.1 and 1.3.2, respectively). You enter data in a spreadsheet before converting it into a chart. The spreadsheet function has limited high-end computational capabilities. Unlike normal spreadsheets that allow formulae to be associated with a single cell, Cricket Graph's calculations consist of taking the values in one column, performing a calculation, and placing the results in another column. In addition to simple mathematical calculations, Cricket also supports advanced functions such as logarithms, exponential powers, and sine/cosine. Logarithmic and polar graph formats are supported, as well.

Once you enter all the data, creating a graph is quick and simple. After selecting the type of graph to create, you select your *x* and *y* axes from a dialog box and the graph is displayed. All the default graph layouts are aesthetically pleasing. Cricket allows all aspects of the displayed charts to be manipulated: colors, hatch patterns, fonts, and so on. The Windows version of the package comes with its own set of 11 high-quality display fonts. In addition to changing colors and styles, you may move and resize each graph element. One of the nicest features is that Cricket Graph lets you move slices of pie charts around for emphasis by simply clicking and dragging on the slice.

One of Cricket's drawbacks is its failure to interactively link the spreadsheet and the displayed graph. Changing the spreadsheet data does not change the graph. Another problem is the program's execution speed under Windows. Although the graph drawing speed on the Macintosh was quite comfortable, the response time under Windows was much slower, even on a 20-MHz 486SX.

If your main requirement is creating nice looking graphs, and you really don't need the power (or expense) of a spreadsheet, then the $129 CA-Cricket Graph is an affordable solution.

—R. C.



DELTAGRAPH PROFESSIONAL 2.0

DeltaPoint's excellent charting program for the Mac will help you generate good-looking, colorful graphs with little hassle. You can enter the data using the program's own columns-and-rows worksheet, which comes up when you open the program, or import data from your usual spreadsheet. Select the data, click on the Plot icon, pick the type of chart you want, then click a button to produce a chart in a separate window. You then can work directly on the chart sheet to change the way it looks. Each element (bar, line, text, and so on) is an object, so you just double-click anything you want to change. Needless to say, this setup makes it very easy to manipulate anything within a chart.

DeltaGraph Pro can generate just about any type of chart you'd want—from standard business graphs to scientific graphs. All told, the package offers 38 varieties, including 10 three-dimensional types and some esoteric kinds such as polar and spider charts. The program lets you have multiple windows associated with each data sheet, so you can have a bunch of different graphs of the same material up on the screen, if you're unsure which graph is most appropriate.

DeltaGraph Professional's color capabilities are considerable. With the shading functions and some other effects, you can design visually sophisticated graphical and textual charts. A set of drawing tools enables you to annotate graphs; another collection of tools lets you set up slide shows.

DeltaGraph Pro takes full advantage of System 7, including Publish and Subscribe. Special hooks are provided to Excel, so you can establish active links between spreadsheet files and DeltaGraph charts. Excel users who'd like a more sophisticated graphing tool than Excel provides should check out the full-featured charting of DeltaGraph Pro.

At $295, DeltaGraph Pro is a good deal. Any functions it's missing are too obscure to concern most business graphers. Best of all, it's easy to use. And the results look good enough to make even a chart full of declining revenues seem less depressing.

—D. B.

EXPRESS PRESENTER 1.0

Power Up Software's Express Presenter charting package provides a fast and efficient way to create 35mm slides and on-screen presentations. Express Presenter can handle 13 chart types that range from outlines and bulleted lists of information to bar, pie, and line charts.

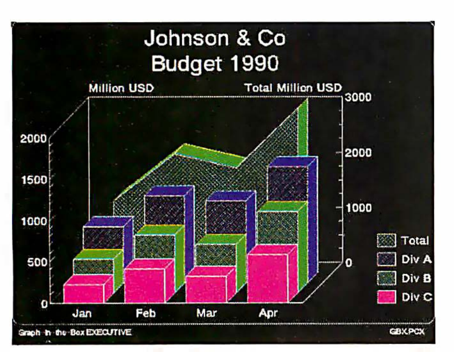
The charts fall into three categories: data, graphical, and annotated. In data mode, you enter information into predefined fields such as title, subtitle, and bullet. Graphic mode automatically translates the data into a presentation-quality screen according to the rules stored in definable style sheets. Annotate modem permits you to place additional text, graphics, and clip art on a slide, and you can overlay charts on each other. Groups of slides may be gathered into slide shows for real-time presentations.

If you've ever felt embarrassed by presentations with misspellings, then you'll love the built-in spelling checker. Unfortunately, you cannot spell-check an entire set of slides with one command. You must check each slide individually.

Express Presenter sells for $199.95 and

arrives with several hundred useful clip art images arranged in four files. Only one of these four files may be used at a time. Oddly, to switch from one clip art group to another, you must first quit the program and start it up again, selecting the clip art file you want to look at and loading it. But this is the only awkward feature in an otherwise easy-to-use program.

—R. C.



GRAPH-IN-THE-BOX EXECUTIVE 1.14

Graph-in-the-Box Executive for DOS is a TSR program that lets you capture numerical data from a screen display within another program and use that data to create as many as 15 different types of graphs. The TSR occupies only 10 KB of memory when inactive.

Graph-in-the-Box is simple to operate. After you run the Graph program, you run a DOS application—a spreadsheet, for example—and then invoke the graphing TSR to capture a portion of the screen. Then you quit your DOS application and use the program's Graph module to quickly and easily create a graph.

One of the first PC graphing tools, Graph-in-the-Box isn't as sophisticated as some high-end packages now on the market, but it does allow you to capture data from a wide variety of DOS programs. The $299 program requires 1 MB of disk space for a complete installation. New England Software also sells a Windows and a network version of the product.

—S. W.

GRAPHMASTER 1.31

GraphMaster, Visual Business Systems' charting program for the Macintosh, is similar to DeltaGraph Pro in that it has a big selection of graph types, uses a spreadsheet-like form for entering data, is very flexible at manipulating data, uses 24 bits of color, and can produce charts that look really good. You can choose from 13 basic chart types (each of which has several variants), including the usual bar/column styles and some statistical/scientific types, such as polar graphs and histograms. Most of them can be represented in 3-D format.

The big difference between the two products lies in the way they operate. DeltaGraph Pro—for me, at least—is a bit more graceful. For example, with DeltaGraph, if you want to try out different types of charts for the same data, you just click on the Plot button and the program automatically opens up a new window for that new chart. With GraphMaster, you must open up a new page before plotting your graph; otherwise, the new chart gets plunked down on top of the one already on the screen. That doesn't present insurmountable obstacles, but it would be nice if GraphMaster got rid of the extra step.

When it comes to working on a chart, though, GraphMaster shines. Besides letting you easily change any element—once you get used to the method of selecting individual elements—the program provides a few spiffy features: gradient backgrounds, color shades, and pictograms (images based on PICT or EPS drawings). You'll even find a set of object-based drawing tools. In fact, it's so easy to customize a chart that it's hard to leave well enough alone.

GraphMaster has numerous data-manipulation functions, including sorting and transposing, and it comes with its own language for developing formulas. The program maintains links between the data window and the related chart; if you make a change to the data, the graph is updated automatically. GraphMaster also can establish a link to data in an Excel spreadsheet. With version 1.3, it fully supports System 7, including Publish and Subscribe, Data Access Language queries, and AppleEvents.

Despite its sometimes unusual procedures, this is an excellent tool that can generate just about any kind of presentation-quality chart or graph a business would need. At $295, it's a good buy.

—D. B.

INSTANT ORGCHARTING 1.0

Instant ORGcharting, another charting program from Roykore Inc., is exactly what its name implies—a method of creating presentation-quality organizational charts in record time. Although it is similar in some ways to the company's ABC Flowcharting product, Instant ORGcharting has a single purpose. This $195 package manages all layout and positioning details for you, while still providing a wealth of options. And, if you don't like any of the nine default layouts, you may manually adjust them.

Each box on the organizational chart has a set of fields associated with it. You can add, delete, and rename these fields at will. Fields can be defined and displayed box by box or you can display an entire chart. Each organizational box may have both a bit-mapped picture and a note box, which are displayed automatically when you select a symbol. Although the documentation and examples are all centered around business/personnel charts, this product is suitable for diagramming any structured information, including hierarchical parts lists.

One excellent feature is the package's ability to import and export ASCII text files to create and edit organizational charts. This feature allows information to be quickly extracted from databases.

Instant ORGcharting allows only a single organizational chart to be open at a time. Its ability to link multiple charts into a hierarchical relationship is a major shortcoming. Although sufficient to create an organizational chart for BYTE's editorial department, a chart covering all of McGraw-Hill would be unwieldy.

Instant ORGcharting is fast and it's simple. An excellent choice for anyone who builds organizational charts more than once.

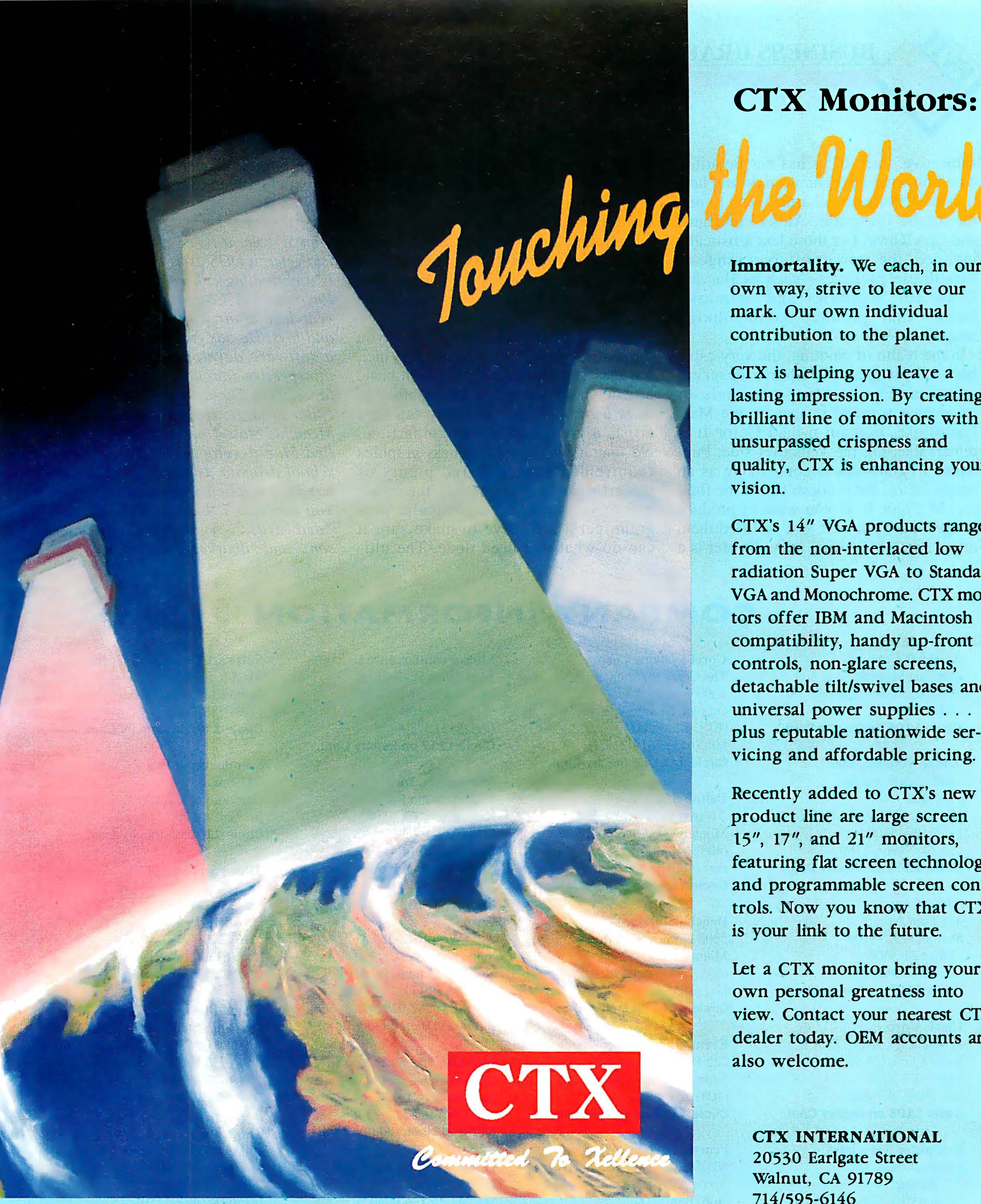
—R. C.

Taking Care of Business Graphics

Remember the childhood excitement of opening a new box of crayons? All those colors to choose from. All those nice, sharp points to work with. The prospect of opening up a new business graphics package can evoke a similar sort of excitement. Too often, though, that excitement is tempered by the fear that you might choose the wrong package.

We can't tell you what to buy, but we can offer a few straightforward guidelines on selecting the appropriate *type* of business graphics program: Buy an object-based drawing package for creating precise, line-oriented artwork; a painting package for free-form illustration or photo touch-ups; and a charting program for producing graphs (although drawing programs such as Adobe Illustrator also are very good at this).

Graphics software, like art, is highly



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subjective. Each of us has our favorites, based on what a program can do and how it does it. Professional artists tend to prefer Adobe Illustrator, Aldus FreeHand, and CorelDraw. For those less artistically inclined, the market offers a range of easy-to-use packages—such as Harvard Draw for Windows and Windows Draw—that produce good-looking images.

In the realm of painting, the very capable and inexpensive Splash deserves mention. For painting originals or retouching scanned images on the Mac, fun-to-use, bargain-priced Color It is remarkable. On the Windows side, Publisher's Paintbrush is comparable as an image editor, but it doesn't have the fluid feel of Color It. If you want to produce images that look as if you've lifted them off an easel or drawing table, Painter is a masterpiece. If you're going to work on technical as well as free-form illustrations, check out Canvas 3.0, which can handle either type of art. For charting and graphing, DeltaGraph Professional and GraphMaster both are winners on the Mac. If you're running Windows, CA-Cricket Graph looks like the best choice for right now.

None of these packages will give you the skill or aesthetic sense of DaVinci, but they can compensate for such basic artistic shortcomings as the inability to draw a straight line. And they can save artists a great deal of designing time. No matter what your business graphics requirements, you'll find plenty of powerful software to satisfy them, but before you settle on a particular program, get a test drive to make sure it can do what you need done. The ultimate buying decision, like your choice of which crayon to use first, really is up to you. ■

Stan Wszola, a BYTE Lab testing editor, is a veteran DOS user. David L. Edwards is a consulting editor for the BYTE Lab. Raymond GA Côté is continuing his 15-year love affair with computers as tools and toys. He has extensive experience as a software developer and designer of interpretive languages and user interfaces. Tom Thompson is a BYTE senior editor at large. He holds a B.S.E.E. from Memphis State University and is a certified Mac developer. D. Barker, an art school dropout, is the BYTE Lab editor handling applications software reviews. You can reach them on BIX as "stan," "dedwards," "rgacote," "tom_thompson," and "dbarker," respectively.

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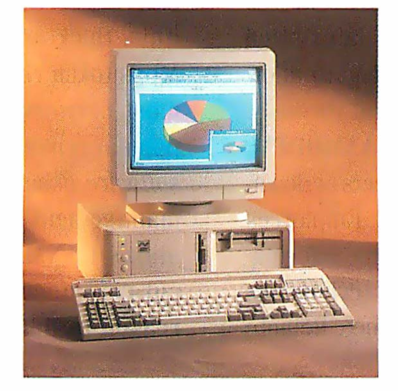
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SOFTWARE

LAN Manager 2.1 Opens the Gates

JON UDELL

Wide-area connectivity, solid Macintosh support, and client-side NetWare integration top the list of improvements that make the new version of LAN Manager the most impressive ever. Despite continuing confusion over the changing roles of DOS, Windows, and OS/2, Microsoft's network strategy is on target and should now begin to pay off. What's the strategy? Quite simply, to tear down barriers to Windows-oriented client/server computing.

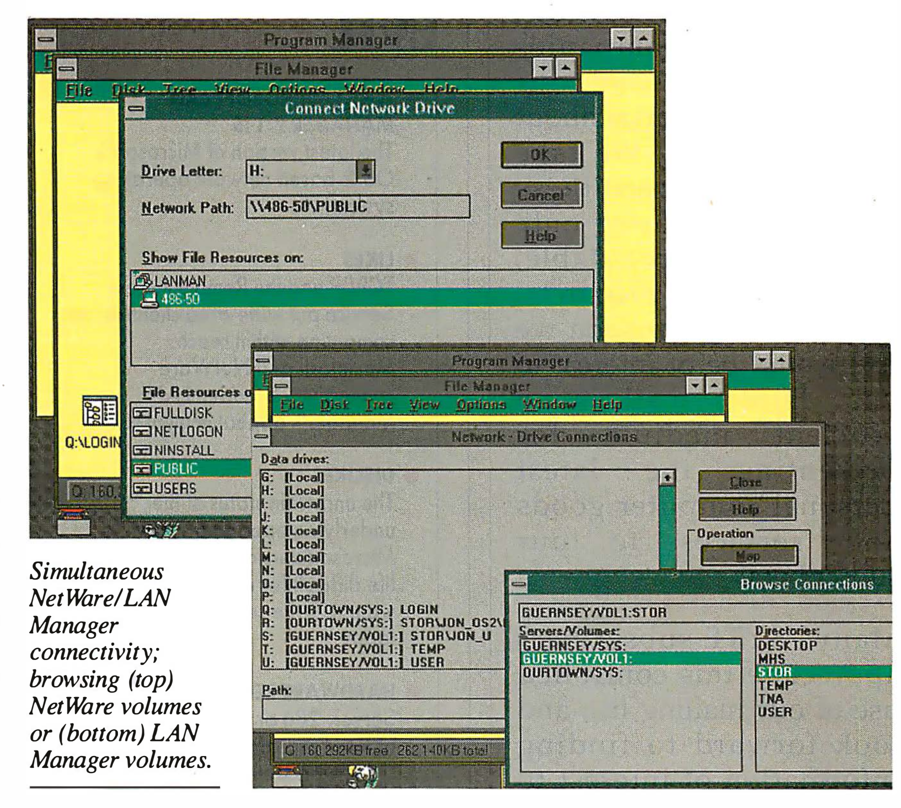
Tapping into TCP/IP

The TCP/IP protocol included with LAN Manager 2.1 is one key strategic move. Although I'm connected to a LAN Manager server as I write these words, there's no NetBEUI stack on my DOS/Windows machine—I'm using TCP/IP. The same transport code that carries files to the server carries icmp packets to BYTE's Unix workstations when I type ping. Microsoft doesn't ship, but plans to offer as a separate product, additional TCP/IP utilities such as telnet and ftp. If you need PC-to-Unix connectivity, you will love not having to burden DOS with an extra protocol to get it. Even if you don't do Unix, though, LAN Manager's ability to ride TCP/IP networks places serious long-haul connectivity within your reach.

LAN Manager 2.1 also comes with libraries that implement Berkeley Standard Distribution sockets for both DOS and OS/2. Although an SNMP agent that monitors a LAN Manager server is the only shipping Microsoft component that uses sockets, I welcome the implicit endorsement of an alternative to named pipes. Kudos to Microsoft for encouraging the development of client/server applications without mandating how they are built.

Remote Access Done Right

Remote access to a LAN can work two ways. From a modem-connected remote PC, you can either capture the screen and keyboard of a LAN workstation (remote control) or drive a true network connection through the phone line. Remote control can be very useful for training and for those aspects of network management that involve "visiting" LAN workstations. However, it isn't really the right tool for remote database access, although it's often put to that task to compensate for non-client/server architectures.



Simultaneous NetWare/LAN Manager connectivity; browsing (top) NetWare volumes or (bottom) LAN Manager volumes.

LAN Manager's new Remote Access Service, by contrast, shines brightest in client/server applications. Like Unix SLIP (serial-line Internet Protocol) and Shiva's NetModem/E, it makes a serial port masquerade as a network adapter. You just load up another NDIS protocol, AsyBEUI, which stands for "asynchronous NetBEUI." Then you can dial up a LAN Manager server running AsyBEUI as one of its protocols and net use its drives and printers just as you would on an Ethernet connection. The LAN Manager server can accept asynchronous connections through its COM ports or by way of a multiport adapter (several popular models are supported). Both DOS and OS/2 clients can dial into the server's Remote Access Service.

Naturally, unless you've got a pair of screaming modems in the circuit, simple file- and print-sharing activities move at a snail's pace. But client/server applications may hardly mind the slow link. I ran the Windows-based administrative tool that comes with the latest release of SQL Server from my home DOS/Windows machine against a LAN Manager server at work. Because relatively small squirts of data passed between client and server—commands, acknowledgments, query results—the setup was very usable even over a 2400-bps connection.

There were two glitches. First, although you can have two simultaneous network connections, serial and Ethernet, LAN Manager's net send command didn't work in that situation. It reported a network adapter error. A Microsoft representative explained that many NetBIOS applications (although of those shipped with LAN Manager itself, only net send) become confused when they see two adapters. Evidently, the NetBIOS software base has some catching up to do. Second, I couldn't get DOS and Windows to do useful work during AsyBEUI transfers—the protocol processing yields virtually no cycles to other tasks.

Remote-access utilities include rasphone, a character-mode dialing program that you use to make and break connections, and rasadmin, a graphical



administrative tool (for both Windows and Presentation Manager) that controls ports, users, and connections. Using rasadmin over a home-to-work connection, I activated the callback feature, and the next time I dialed in, the server called me back.

BYTE ACTION SUMMARY

WHAT MICROSOFT LAN MANAGER 2.1 IS
The latest version of Microsoft's OS/2-based network operating system.

LIKES
TCP/IP and the Remote Access Service put wide-area client/server computing within reach. Macintosh and NetWare connectivity broaden LAN Manager's appeal immensely.

DISLIKES
The uncertain status of the underlying operating system, a Microsoft version of OS/2, makes life difficult for developers who want to write server applications today.

HARDWARE REQUIREMENTS
Server: 286 or higher; 9 MB of RAM recommended.
OS/2 workstation: 286 or higher; 4.5 MB of RAM recommended.
DOS workstation: 8086 or higher; 640 KB of RAM and extended/expanded memory recommended.

RECOMMENDATIONS
Use it alone, or in conjunction with NetWare, as a foundation for Windows-oriented client/server computing.

PRICES
Server software with 10-user license, $1995
Unlimited user pack, $5495
Macintosh services, $995
Remote Access Service, $1995
Visual Basic toolkit, $135

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Living with NetWare

Thanks to one more new NDIS protocol, DOS clients can connect simultaneously to LAN Manager and NetWare servers. When you install LAN Manager's new NetWare-connectivity feature, the setup program prompts for your SHGEN (or WSGEN) disk and builds an NDIS-compliant IPX.COM. Now you can load the NetWare and LAN Manager shells at the same time—a wonderfully convenient, if somewhat ungainly, arrangement. While I would rather see Microsoft and Novell cross-support SMB and NetWare Core Protocol in their servers, LAN Manager's client-side NetWare connectivity is a laudable step in the right direction.

What puts it a cut above other dual-shell solutions I've tried is the superb Windows integration. A new Windows network driver, DUALNET.DRV, sorts out access to the two flavors of network resources. When you select Connect to Network Drive in the File Manager, for example, the driver asks you to choose between LAN Manager and NetWare. Running Windows 3.1, I connected to drives on both servers and then used drag-and-drop to move files back and forth between them.

The same LAN Manager/NetWare choice appears when you select Printers in the Control Panel. I routed LPT1 through a NetWare queue to a LaserJet and LPT2 through a LAN Manager queue to a LaserWriter (on an AppleTalk network, actually), and then I monitored both queues in Print Manager.

All this juicy interoperability takes a predictable toll on DOS and Windows. Loading both shells brought free conventional memory down to about 470 KB. Windows had to load half a dozen VxDs to support the two networks in enhanced mode. I could unload either network shell, but I had to quit Windows first. When I restarted Windows minus one or the other of the shells, it still expected to see both and so complained about the missing one—although it ran fine. And, of course, I could only unload in the reverse order of loading; so, to switch from LAN Manager plus NetWare to NetWare alone, I had to unload two shells and then reload one. Ultimately, though, LAN Manager's NetWare-connectivity feature rises above the peculiarities of DOS and Windows. It's incredibly useful.

LAN Manager for Macintosh

The new Macintosh services, formerly available from 3Com but, thankfully,

now a standard option, worked flawlessly. Installation was a snap, in part because I didn't make the server a *seed router* and so didn't have to define AppleTalk zones and network numbers. My Ethernet-connected LAN Manager server talked to BYTE's AppleTalk LAN by way of a Cayman Systems GatorBox. Alternatively, I could have installed a LocalTalk adapter in the server and had LAN Manager do the Ethernet/LocalTalk routing. (Note that NetWare-style internal routing, never a feature of LAN Manager, still is not; you can't, for example, join token-ring and Ethernet segments at the server to create a single logical network.) The Mac services support a maximum of 50 users; that's a hard limit, related to the availability of threads in OS/2 1.x.

The file-sharing service, MacFile, works with existing LAN Manager user accounts, so there's no administrative overhead there. You do have to explicitly share out volumes. Permissions and filenames map across the cultural chasm pretty much as you'd expect, and there's one nice enhancement that NetWare for Macintosh doesn't provide. LAN Manager maintains a list of DOS file extensions and a mapping from these to Macintosh Type and Creator strings. So when I copied a .DBF file and a .TXT file to the server, Mac clients immediately saw these as FoxBase+ and Microsoft Word documents. You can use the `macadmin` utility to change the mappings if, for example, you want Mac folks to see .TXT files as MindWrite documents instead. The same tool can also monitor active shares, which is handy.

The MacPrint service can export LAN Manager–connected printers to the Mac population, link PC users to AppleTalk-connected printers, and interpose queuing between Mac users and their own printers. Figuring out how to do all this can be confusing, in part because you have to make OS/2 and LAN Manager agree on printer and queue definitions. Eventually, I got everything to work. MacPrint caches LaserPrep files so Mac users needn't retransmit them, and it can "capture" AppleTalk printers so you can ensure spooled access and centralize job control.

Installation Central

Remote installation is an intriguing but frustrating feature of LAN Manager 2.1. You install the workstation software at the server and create a bootstrap disk. You boot a workstation from the disk, and it connects to the server and pulls the necessary files across the network.

But Microsoft failed to parameterize the installation so you can specify your version of DOS, your network adapter, and your adapter settings on the fly. Instead, the company recommends that you set up one directory on the server for each combination of these variables.

Visible Seams

The role of OS/2 remains problematic. To spare you the trouble of hunting for a compatible version of OS/2 to put underneath LAN Manager, Microsoft now includes a modified version of OS/2 1.3. Thanks to the LADDR (Layered Device Driver Architecture) extensions in this version, LAN Manager (and the new version of Sytos Plus bundled with it) works with a healthy variety of SCSI adapters.

Yet thick irony surrounds these welcome developments. With IBM leading the OS/2 charge and Microsoft advancing on the Windows NT front, it's hard to take Microsoft OS/2 1.3 seriously as a platform for the server parts of client/server applications.

OS/2's role confusion affects LAN Manager's client-side offerings as well. For historical reasons, OS/2 workstations have a number of advantages over DOS workstations in LAN Manager networks. For example, OS/2 clients can use server modem pools and can manage servers remotely; DOS clients can't. Yet sexy new features, like NetWare connectivity and over-the-network installation, aren't made available to OS/2 clients; they're for DOS/Windows clients only.

Utilities are another anomaly. The company whose strategy is "Windows, Windows, Windows" continues to lean on an awful lot of character-mode DOS utilities. Only `rasadmin` is a Windows program—and also an OS/2 program, by the way, thanks to the Windows Libraries for OS/2. This despite Microsoft's offering of a Visual Basic toolkit that encapsulates the LAN Manager application programming interface, to simplify development of Windows-based LAN Manager utilities.

Does Microsoft's shifting platform emphasis cast doubt on the future of LAN Manager? In principle, Windows NT should slide neatly under LAN Manager, but only time will tell. Meanwhile, I'm quite pleased with the 2.1 product. Key strategic advances—TCP/IP, remote access, Mac services, and NetWare connectivity—should make every savvy network integrator sit up and take notice. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

HARDWARE

New MultiSyncs Prove That Flatter Is Better

ALAN JOCH

Although NEC's MultiSync sales have traditionally led the multi-scanning-monitor market, consumers are benefiting from a wave of monitors that offer larger screens, higher noninterlaced resolutions, faster refresh rates, and flatter displays than many of NEC's products. Sony's flat-panel Trinitron displays and Nanao's innovative FlexScan series, for example, have challenged the MultiSync's stature.

NEC's response is the new FG line, which updates the MultiSync line with new sizes, crisper displays, and innovative features such as a built-in color calibrator.

The Line

The FG line will replace NEC's existing MultiSync 3DS, 4DS, and 5D. The two new 15-inch FGs, the $949 4FG and the stripped-down $799 3FGx, began shipping late last year. At press time, two larger-screen versions came to market: the 17-inch 5FG and a 21-inch 6FG. Both the $1699 5FG and the $3499 6FG display up to 1280 by 1024 pixels at 74 Hz noninterlaced.

All the FGs sport flat-square displays, which, while not flat panels like Sony's Trinitron tube, present realistic images and text with little distortion. The microprocessor control panels on the FGs let you easily size and position the display area and save your settings in memory. NEC's unique integrated color-calibration system (on all but the 3FGx) allows you to match screen colors to those of your printer or service-bureau output. Each FG complies with Sweden's MPRII ELF and VLF emissions standards, according to NEC.

Testing the 4FG

I tested the 15-inch 4FG, whose price and sharp display promise to make this model the most popular in the FG line for Windows- and Macintosh-based business applications. The 4FG offers the standard check-off items for business monitors. It has a 0.28-mm dot pitch, and it supports VGA, Super VGA, 8514/A, noninterlaced 1024- by 768-pixel display, and XGA modes. With the optional $20 interface adapter, the 4FG supports Mac II and LC users.

The 4FG's maximum resolution of 1024 by 768 pixels will serve most business users today, but given the rapid introductions of higher-resolution and relatively low-cost graphics cards that run at 1280 by 1024 pixels, the 4FG could soon run out of headroom. Those who require the higher resolution must look to the larger 5FG or 6FG and their substantial increase in price.

When displaying its maximum resolution, the 4FG supports either 60 Hz or 70 Hz in noninterlaced mode. The monitor supports 72 Hz when running 1024 by 768 pixels in interlaced mode or 800 by 600 pixels and VGA resolutions.

The front-panel controls are in easy reach and make it a breeze to resize and position the display. Included in the panel is a degauss button that you press to clear stray magnetic fields. When you switch to color mode, the same controls let you adjust the display colors to add or subtract percentages of red, green, and blue. You can select and save into memory up to three color-level combinations to match specific color models or service-bureau output. A sync switch on the panel lets you select the monitor for use with PCs or Macs.

The 4FG presents a bright, high-contrast display (thanks in part to an Invar shadow mask) that I found easy to read even after hours of editing manuscripts. The 15-inch display was large enough to work comfortably in Windows. I noticed no flicker even when I ran it at 1024 by 768 pixels. Windows icons, while small, remained easily discernible in the highest resolution.

I found the optional monitor lens ($79) to be practically a necessity. The contrast that makes the display so appealing lessens considerably without the lens. Likewise, glare is a problem without the lens (background reflections existed even when the lens was in place). Overall, however, I prefer the deep black, glare and all, in the 4FG to the antiglare, flat-black coating on a MultiSync 3D in the BYTE Lab.

NEC deserves credit for designing a bevel around the outside of the display that lets you slip the lens onto the monitor. Unlike most covers of this sort, the MultiSync lens looks like an integral part of the overall unit and not something slapped on as an afterthought.

Close examination of the screen revealed some pincushioning: waviness and bowing of vertical lines. This was most evident when a window abutted the corner of the display. The FGs provide



An optional slip-on lens reduces glare and improves contrast in the MultiSync 4FG's already-sharp display.

BYTE ACTION SUMMARY

■ **WHAT THE MULTISYNC 4FG IS**
A 15-inch, flat-square display for PCs and Macintoshes.

■ **LIKES**
Crisp, high-contrast display; integrated color calibrator.

■ **DISLIKES**
Slight but noticeable wavy lines (pincushioning) when running Windows; maximum resolution of 1024 by 768 pixels.

■ **RECOMMENDATIONS**
For general business applications that don't require higher than 1024-by 768-pixel resolution, the 4FG is a solid choice for displaying crisp colors and text.

■ **PRICE**
$1028 as tested with optional ($79) monitor lens

■ **FOR MORE INFORMATION**
NEC Technologies, Inc.
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Wood Dale, IL 60191
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adjustments within the color-calibration mode to increase or decrease pincushioning, and I found these controls to be generally effective. However, the outside edges of the Windows screens remained wavy to some degree no matter how much I adjusted the controls. In practice, though, this distortion didn't affect my work. In addition, the light background of Windows helped reveal a hot spot in the center of the display: The middle of the screen was noticeably brighter than at the edges.

I evaluated the MultiSync 4FG with the optional lens using Sonera's DisplayMate software, which provides a series of test screens to determine display quality. For comparison, I ran the same tests on an NEC MultiSync 3D, a 14-inch display, and Sony's new CPD-1604S, a 16-inch Trinitron monitor priced at $1700 (for a complete review of the CPD-1604S and dozens of other high-resolution monitors, see the BYTE Lab Product Report on monitors coming in May). My test platform consisted of a Tangent 320s 20-MHz 386SX with ATI Technologies' Graphics Ultra graphics board (a 1-MB video RAM accelerator that runs ATI's Mach 8 coprocessor, an 8514/A clone).

The DisplayMate test screens highlighted some of the flaws I noticed when working with the monitor. But overall, the display proved to have accurate screen uniformity and almost no geometric distortion, and it was on target with color registers. I noticed no ghosting and only slight persistence with the monitor. It passed DisplayMate's pincushioning test, probably because the test screen background is black and the test lines are white. As I've mentioned, when the display is pushed harder to reproduce black lines on a white background, distortion crops up.

I note all this for the record, but my overall satisfaction with the 4FG is high, especially considering its $949 price. The Sony CPD-1604S didn't exhibit wavy pincushion lines, and its crisp display breezed through the DisplayMate tests. But for the money, the 4FG is an impressive monitor. It offers a nice compromise for those who want better performance and a larger display than 14-inch monitors but balk at the prices of the finest 16-inch and larger monitors. As I've noted, the maximum resolution of 1024 by 768 pixels is part of that compromise.

If you're a GUI-centric business user looking to enjoy what today's multiscanning monitors have to offer, the MultiSync 4FG is a sound choice. ■

Alan Joch is a senior technical editor and director of the BYTE Lab. You can contact him on BIX as "ajoch."

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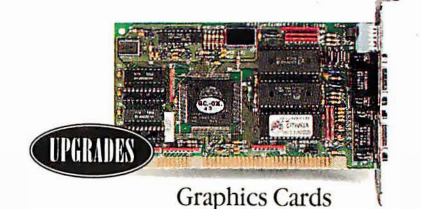
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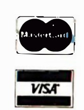
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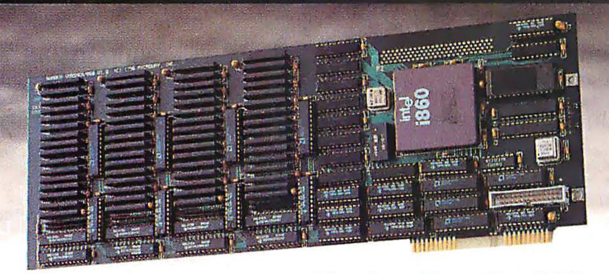


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HARDWARE AND SOFTWARE

Video Goes Digital with Fluency

TOM YAGER

Many of us who track the rapid growth of multimedia technology share a common view of the future: Video will enjoy widespread use as a data type. This will stem partly from the undeniable appeal of viewing moving video on your computer's display. But the practical benefits of tagging E-mail, database records, and documents with video clips far outweigh the "gee-whiz" value.

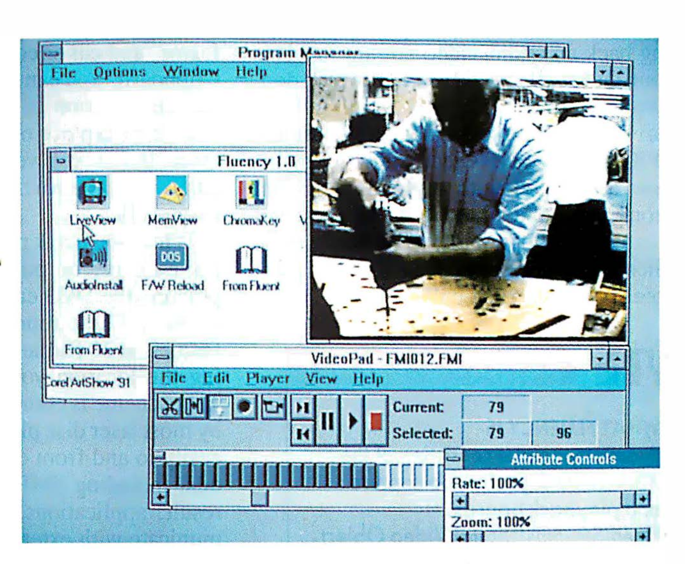
To bolster this view, a new generation of multimedia technology is emerging out of earlier, more primitive attempts at turning moving video into digital data files. With Fluency, Fluent Machines is among the first companies to package one of these new digital-video technologies for broad use. Fluency is a combination of PC hardware and software that lets you capture moving video images in real time and store them in files on your hard drive. You can play back that video with perfectly synchronized audio in a window on your PC's monitor.

Most significant is FluentStreams, the software component that enables developers to easily build digital video into applications. For nondevelopers, Fluency offers a glimpse of how digital video can be integrated into general desktop applications.

Most of Fluent Machines' work in digital video focuses on software and standards, but since no other company was shipping digital-video hardware late in 1991, Fluent Machines created the VSA-1000. This first-pass hardware was constructed to give eager developers a jump on creating digital-video applications.

The VSA-1000 has some pretty impressive specifications: real-time capture and playback of moving video and synchronized audio at a variety of bit rates (ranging roughly from 384 Kbps to 2 Mbps); image compression through an on-board C-Cube JPEG chip; the ability to simultaneously display live incoming video and captured video playback in separate windows; digital "zooming" of live and captured video (up to 300 percent); and pass-through of a standard VGA signal.

Since the VSA-1000 is planned for obsolescence, I won't dwell on its shortcomings. It does, however, illustrate that digital video has some way to go before everyone will want it. The minimum requirements for a Fluency host system are 8 MB of memory, a 25-MHz 386, and *three* empty slots. One of the VSA-1000 boards has a daughtercard that juts out far enough to obscure the neighboring slot. No matter how you slice it, you're talking about a big system. The new boards in development are reportedly trimmer, less demanding, and much easier to install.



Fluency's VideoPad application records, plays, and edits video clips. Programmers can use FluentStreams library functions to build digital video into their own programs.

Future hardware likely to be supported by FluentStreams includes other JPEG boards, and these are likely to behave much like the VSA-1000. Other standards, like MPEG and Intel ActionMedia II, use compression schemes that preclude certain capabilities (like quick random access). So while FluentStreams will adjust to any digital video hardware, its capabilities are inevitably tied to those of the hardware being used.

Down by the Video Stream

I installed the Fluency hardware and software in a Tandy 4033 LX Multimedia, a 33-MHz 386 system with MPC-compatible CD-ROM and audio gear. I connected the video and audio outputs from an NEC PC-VCR (a computer-controllable Super VHS VCR) to the VSA-1000's input jacks.

The real heart of Fluency is FluentStreams. This is a scheme for manipulating digital-video hardware and video and audio files, and a foundation for digital-video applications. It is hardware-independent, so it will adapt to whatever hardware becomes popular. Several vendors have already agreed to make FluentStreams part of their digital-video solutions. The software is also geared to work with playback-only systems. Inexpensive full-motion video playback hardware is expected to hit the streets soon from a variety of sources.

FluentStreams will also adapt itself well to the coming software-only playback (digital-video playback without hardware assistance) and the transmission and storage of video clips through networks. Developers who write to FluentStreams may have the best chance of having their applications run on these, and other, future systems.

For the developer, FluentStreams takes the shape of a digital-video application programming interface that offers precise control over capture and playback, live video (video-in-a-window), and digitized audio. FluentStreams supports not only playback of digital-video clips, but editing of them as well. The FluentStreams API is based on the concept of Digital Video Objects—windows in Microsoft Windows that understand how to deal with video and audio. As far as Windows programs are concerned, DVOs are full-fledged windows; they can be manipulated using regular Windows calls and referenced through ordinary window handles.

FluentStreams defines three flavors of DVOs that cover what most digital-video applications might need: an analog input object that displays external (live) video

in a scalable window with audio pass-through; an audio stream object that can record and play digitized audio files; and an audio/video stream object that manipulates digitized audio and video. You can work with DVOs at a simple level. Playing back an audio/video stream involves four DVO calls: `DvoCreateAudioVideo`, `DvoShow`, `DvoLoad`, and `DvoPlayForward`. This simple sequence creates the DVO audio/video object, shows the window associated with it, loads a stream from disk, and plays it. Even the `DvoLoad` call is optional, since the stream filename can be specified with the `DvoCreateAudioVideo` call.

BYTE ACTION SUMMARY

- **WHAT FLUENCY IS**
  A developer's kit consisting of the VSA-1000 digital-video capture and playback boards, FluentStreams/Digital Video Object programming libraries, and a handful of applications.

- **LIKES**
  Very well designed programming interface that includes precise video editing; consideration (through varying bit rates) for storage types covering the range from hard drives to CD-ROMs and networks.

- **DISLIKES**
  Same as with all digital video: diminished image quality (compared to videotape or laser disc); extreme system and storage requirements.

- **RECOMMENDATIONS**
  Developers intending to market digital-video applications should consider writing to FluentStreams; the Fluency package will give you everything you need to get started.

- **PRICE**
  VSA-1000, $3995
  FluentStreams, $495

- **FOR MORE INFORMATION**
  Fluent Machines, Inc.
  1881 Worcester Rd.
  Framingham, MA 01701
  (508) 626-2144
  fax: (508) 820-1106

  Circle 1221 on Inquiry Card.

Making the Cut

Once you open a video/audio or video stream, you can use DVO functions to edit the stream's contents as easily as if they were text. You can select a portion of a stream, down to an individual video frame, and cut or copy it to the Windows Clipboard. You can then paste that clip to another location in the stream, where it can either replace or add to data already there. After you've applied a series of edits, you can save the finished result to a stream file.

When you mark part of a video stream for editing, or position the playback pointer, the DVO calls expect frame addresses. These represent the number of frames, at 30 frames per second, preceding the location you wish to represent. This scheme is compatible with that used by most laser disc players, and it converts easily to and from other reference methods, including SMPTE time code. As a result, applications that expect to communicate with external laser disc players and other video gear can be easily converted to work instead with DVOs.

Practically Speaking

There are two ways to put Fluency, and products like it, to work. The simplest way is to use the applications provided by the vendor. In this case, Fluent Machines includes several useful programs, the best of which is called VideoPad (see the screen). This Windows program can play, capture, and edit video/audio clips and offers control over most of the VSA-1000's capabilities, including capture bit rates. At every rate, FluentStreams keeps the audio locked to the video and keeps the motion as smooth as the level of detail will permit.

I also wrote a small custom application using the FluentStreams library. To save time, I wrote it in OpenScript, the programming language behind Asymetrix's ToolBook. The original program opened a live video window (using New Media Graphics' Super Video Windows card) and placed buttons under it that sent positioning and playback commands to my PC-VCR. Each graphical button was tied to a different scene on the tape, which the PC-VCR located by frame number. The drawback to this original application was that, even though the PC-VCR is particularly responsive, it took several seconds to shuttle the tape from scene to scene.

It took less than an hour to replace the PC-VCR and Super Video Windows calls with rough FluentStreams equivalents. I used VideoPad to create a single stream file that included all the taped segments. I then converted the button code to play predefined segments in that loaded stream. After the initial overhead of opening and loading the stream file, response time proved to be significantly better than that of the original external-video version of my application.

That's not to say there weren't drawbacks, but they have nothing to do with FluentStreams. Most of the problems related to image quality. The original application took advantage of the PC-VCR's high-quality Super VHS output and displayed it in a large window; the video looked good even at 640 by 480 pixels. Moving to digital video, even at the highest bit rate and in a smaller window, resulted in a huge step down in image quality. While it served well for "talking heads" and other trivial subjects, it fell apart when the image included complex visuals like handwriting and detailed graphics.

Issues like these aside, writing a FluentStreams application using ToolBook proved easy enough to be enjoyable. Programming in C, or any other language that can tie into Windows dynamic link libraries, should not prove much more difficult. Fluent Machines has packaged so much functionality into a handful of calls that digital-video applications are a snap to create.

So Many Questions

Should you go with analog (external, videotape-based) or digital? Analog is inexpensive and universally viewable, and it delivers a very high quality image. Today's digital solution is more expensive, has lower quality, and requires specialized hardware and software (not to mention lots of storage), but it offers near-immediate access and very precise control.

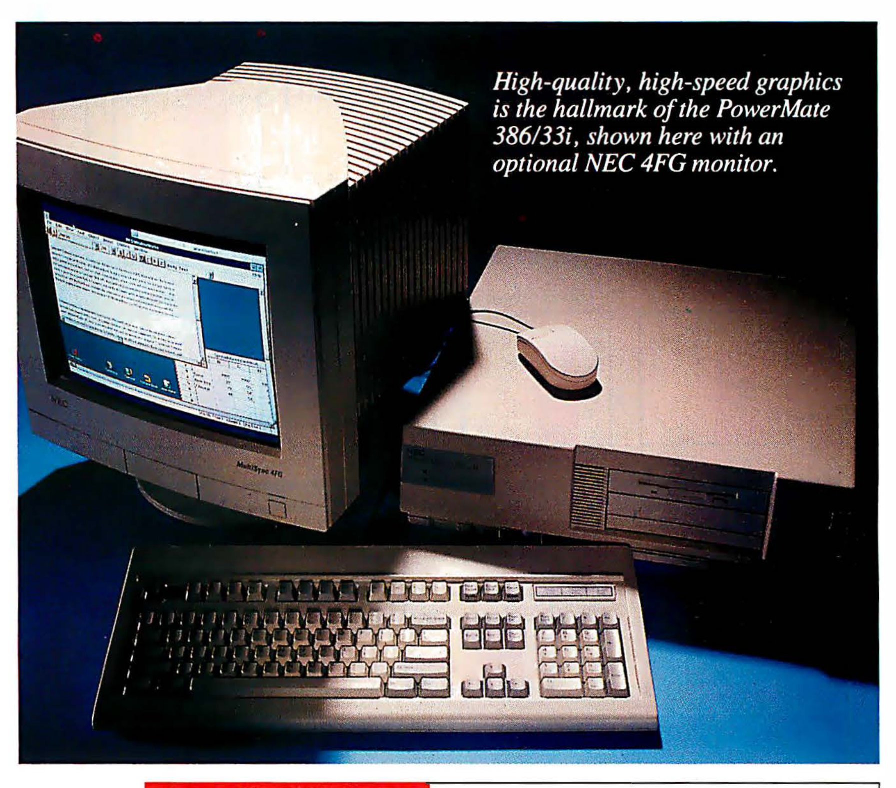
Is it difficult to build digital video into applications? The answer, thanks to Fluent Machines, is a boisterous *no*. The company's dealings with others venturing into the digital-video realm make FluentStreams a name to watch. As digital video, which is still in its infancy, grows to take on better image quality and storage efficiency, I expect FluentStreams to keep pace. So even though digital video has a long way to go before it's ready for the average desktop, you can start building today the video-capable applications that users will want tomorrow. ■

Tom Yager is a technical editor and director of the BYTE Multimedia Lab. You can contact him on BIX as "tyager" or through the Internet at tyager@bytepb.byte.com.

SYSTEM

Local Bus Fuels PowerMate's Graphics Response

STEVE APIKI


High-quality, high-speed graphics is the hallmark of the PowerMate 386/33i, shown here with an optional NEC 4FG monitor.

Even the simplest application you'll find on a software dealer's shelf today will likely sport a GUI. Graphics make software more attractive and easier to use. Unfortunately, interactive graphics can also demand enough resources to choke otherwise capable systems. As applications have grown more graphical, they've required faster, more expensive systems to supply minimum acceptable performance.

The NEC PowerMate series marries high-performance graphics with mid-range systems to create highly usable, general-purpose graphics machines. The PowerMate 386/33i is an excellent example of this design philosophy. Its graphics performance is solid, and screen updates in Windows and other graphics applications are snappy. This system *feels* faster than it really is. High-speed graphics hardware shortens response time enough to make the PowerMate, with modest processing power and a modest price, seem like a real screamer.

Graphic Improvement

The PowerMate's graphics system is a local-bus video design. In this arrangement, the video subsystem is not hooked to the standard peripheral (ISA) bus; instead, it's wired directly to the CPU bus, which it shares with cache memory and the cache controller. When the CPU reads or writes video memory, it does so on the 33-MHz clock of the processor bus, not on the 8-MHz cycles of the ISA bus. Obviously, this greatly enhances video performance. NEC claims that the PowerMate can save up to an additional 200 nanoseconds per video access by avoiding the synchronizing delays imposed by the ISA bus.

Local-bus technology has been the focus of industry attention of late, with the Video Electronics Standards Association recently recommending a local-bus standard and several manufacturers developing local-bus architectures. But NEC takes a proprietary approach to local-bus technology in the PowerMate, preferring to hard-wire video to the CPU bus and tweak for performance rather than design for expandability and third-party upgrades.

ACTION SUMMARY

WHAT THE NEC POWERMATE 386/33I IS
The PowerMate 386/33i is the first Intel-based system to take advantage of local-bus video processing.

LIKES
Video performance is outstanding. When coupled with a MultiSync 4FG monitor, the 386/33i also provides excellent image quality.

DISLIKES
The PowerMate 386/33i's underpowered processing system makes it only an average performer overall.

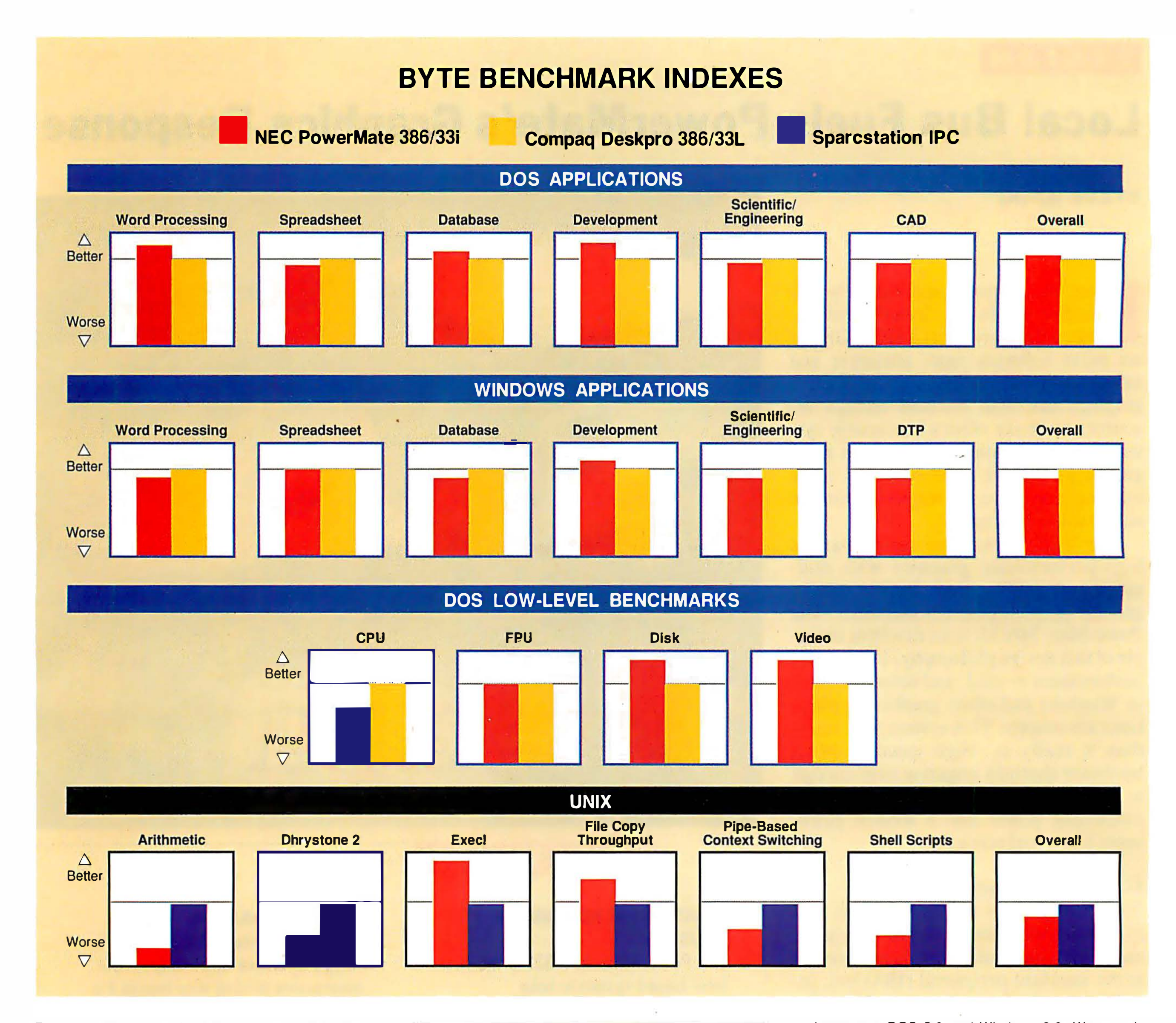
RECOMMENDATIONS
The PowerMate 386/33i is best for image-intensive applications, but aggressive pricing also makes it a good choice for general Windows or DOS use.

PRICE
$4208 (as tested)

FOR MORE INFORMATION
NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(508) 264-8000
fax: (508) 264-8673
Circle 1223 on Inquiry Card.

My test system included a 33-MHz 386DX processor with a 32-KB cache; 4 MB of 80-ns RAM; a 60-MB 16-millisecond IDE hard drive; a 1.44-MB floppy drive; integrated (1-MB) Super VGA video; a MultiSync 4FG monitor; four 16-bit slots; one serial port; one parallel port; one PS/2 mouse port; headphone and microphone jacks; a 101-key keyboard; MS-DOS 5.0; and Windows 3.0.

continued



Except for the conventional benchmarks, all results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Compaq Deskpro 386/33L running Compaq DOS 5.0 and Windows 3.0 = 1. For each index in the Unix tests, a Sun Sparcstation IPC = 1. The overall index is the average index of the individual tests.

The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you to identify the relative performance of a given subsystem and to determine where performance bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990 BYTE. The BYTE low-level benchmarks, version 2.2, are available in the byte.bmarks conference on BIX, or you can contact BYTE directly.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments, DOS 5.0 and Windows 3.0. We test six application categories for each environment, running test scripts using the following programs: Word Processing: WordPerfect 5.0 and Lotus Ami Pro 2.0; Spreadsheet: Lotus 1-2-3 release 3.1+ and Microsoft Excel 3.0a; Database: Software Publishing Superbase 4 1.3 and Ashton-Tate dBase IV; Development: Borland Turbo Pascal for Windows and Microsoft C 6.0; Scientific/Engineering: MathSoft MathCAD for Windows 3.0, MathWorks MatLab 3.5k, and Computing Resource Center Biturbo Stata 2.1; CAD: Autodesk AutoCAD release 11; and Desktop Publishing: Aldus PageMaker 4.0. The data files and test scripts are available from BYTE.

Our Unix tests show relative performance for double-precision arithmetic, the Dhrystone 2 benchmark, spawning a process (execl()), file copy throughput (in 5 seconds), pipe-based context switching, and running a shell script with eight concurrent scripts running. Unix benchmarks are available on Usenet, from Demolink, in the listings area on BIX, or on disk.

CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
NEC PowerMate 386/33i	0.32	14725.3
Compaq Deskpro 386/33L	0.32	14724.3

BYTE's low-level video benchmarks (see the figure) illustrate the speed of the PowerMate 386/33i's local bus. These benchmarks are not measurements of raw memory-access speed; they also include BIOS operations and times for calculating pixel placement. The PowerMate 386/33i proved about 25 percent faster than a Compaq Deskpro 386/33L on these tests, which is a good representation of the real graphics performance improvement you can expect.

But while graphics performance was excellent, the PowerMate turned in only average numbers overall, performing at about the level of the Compaq Deskpro 386/33 on our DOS and Windows application tests. To be fair, our Windows benchmarks run in 16-color mode, and the PowerMate would undoubtedly have more of an advantage at 256 colors. Unix benchmarks showed that the PowerMate is a capable Unix workstation. Still, CPU tests revealed a noticeable bottleneck in

the system; the PowerMate's limited 32-KB cache made it significantly slower than the Deskpro at raw memory-access tests.

Good Looks, Too

Speed is not the PowerMate 386/33i's only graphics-system innovation. When it is paired with an NEC MultiSync FG-series monitor, the PowerMate automatically sets itself for the highest supported resolution and refresh rates. The built-in video system comes with 512 KB of RAM and supports noninterlaced, 70-Hz resolutions of up to 1024 by 768 pixels at 16 colors. You can upgrade to 1 MB of video RAM (VRAM); this gives you 256 colors at 1024 by 768 pixels and pushes the maximum 16-color resolution up to 1280 by 1024 pixels interlaced.

My review unit included 1 MB of VRAM and a MultiSync 4FG monitor. In 1024- by 768-pixel Windows, the view is just stunning. The 4FG handles 70-Hz refresh for a steady, beautifully clear and bright picture. (For a review of the 4FG, see "New MultiSyncs Prove That Flatter Is Better" on page 262.)

Take the monitor off the system, twist a clip on the back of the system unit, and the case pops off readily. It goes back on just as easily. While I don't usually get excited about well-designed cases, the PowerMate deserves recognition in this area. The drive and mounting bays snap out without tools, and motherboard-mounted components are easily accessible. Adding a coprocessor or upgrading memory (to 64 MB) is just a few minutes' work.

The PowerMate 386/33i has other nice touches: Although it is not designed as an expandable system, the PowerMate provides BIOS in flash memory so that BIOS updates can be downloaded from a floppy disk. Together with the easily disassembled case, this feature makes minor upgrades trivial. It also has headphone and microphone jacks, and Windows comes preinstalled on the system.

Its advanced video features, however, are what set it apart. Supercharged video and a $3249 price ($4208 with the 4FG monitor and 1-MB video upgrade) make this system an excellent choice for Windows or any application where interactive graphics is important. As more and more applications join that category, the PowerMate 386/33i and systems like it become even better selections. ■

Steve Apiki is a BYTE technical editor with a B.S.E.E. from Rensselaer Polytechnic Institute. You can contact him on BIX as "apiki."

NCR 3447 Serves Up Unix

The February Solutions Focus compared high-performance file servers from Compaq, Advanced Logic Research, Tricord, Tangent, and Dell. Each included a built-in drive array for very high disk throughput and increased immunity to data loss.

Just after that review was completed, NCR delivered its own built-in drive array. We tested it in NCR's 3447 workgroup server, a 50-MHz 486-based Micro Channel system. Although the 3447 can support up to four 486 processors, we tested it in a single-processor configuration with a 128-KB second-level cache. Our test system also included 16 MB of RAM, an NCR Micro Channel Ethernet adapter, a SCSI controller, and a VGA graphics system. With the 2.1-gigabyte array bundled in (which accounts for $27,500 of the price), this super server sells for $45,085.

NCR's drive array is a RAID (redundant arrays of inexpensive disks) level 5 system that can be set up for highest performance or to provide redundancy for data protection (for an explanation of RAID, see "File Servers Face Off," February BYTE). The array that we tested consisted of five 670-MB Seagate SCSI drives configured for RAID level 0 (striping only). We ran our tests under NCR's Unix System V release 4.

The table shows the results of BYTE's Unix network server tests for NCR's 3447, Compaq's Systempro, and Tangent's Multi-Server. When comparing results, keep in mind that the Compaq and Tangent systems are 33-MHz 486-based machines, which we tested with arrays of four, not five, drives.

The 3447's random I/O performance was outstanding. On sequential tests, where fast processor performance matters less than drive controller throughput, the 3447 performed only at the same level as Tangent's fast Multi-Server. But for the majority of operations, this first 50-MHz 486 server we've tested earns the title of fastest server we've seen.



NCR's 3447 50-MHz processor and high-speed drive array place it among the fastest Unix file servers we've tested to date.

BYTE UNIX NETWORK BENCHMARK RESULTS

NCR's 3447 outruns some of the fastest competitors available.

	Compaq Systempro	Tangent Multi-Server	NCR 3447
Random I/O with transmissions (Kbps)			
One node	284	335	476
Three nodes	140	173	313
Six nodes	61	95	198
Sequential I/O with transmissions (Kbps)			
One node	226	240	249
Three nodes	86	124	116
Six nodes	42	61	55

Connect Printers Without Wires

Although it debuted in North America at 1991's Spring Comdex, Infralink, by the company of the same name, didn't receive FCC Class B approval until late last year. Now ready for prime time, Infralink generally delivers on its promise of quick and wireless connections among PCs and printers.

Infralinks use the parallel port to connect to PCs and printers. When you send a print command, the two devices pass the file using infrared light, broadcasted rather than sent as a direct beam. This, in theory, reduces problems associated with line-of-sight obstructions. According to the company, up to eight PCs and printers as far as 230 feet apart can communicate using Infralink.

The company claims that at distances of up to 23 feet, Infralink will work without any special orientation of the modules. Our tests bore this out: At roughly 20 feet we could establish almost instantaneous connections, although we sometimes had to twist the receiving module around in the air. At 40 feet, across four rows of cubicles, we were never able to successfully send a print message. Infralink says that at that distance, the sending modules should be wall mounted and angled in the direction of the receiving unit.

For those who can't bear the cost and effort of rewiring connections, Infralink is a possible alternative. However, each module costs $320. So the minimum price of $640 to get one printer and one PC talking would make us explore some more conventional print sharer avenues before we took the plunge into wireless communications. ■

Reviewer's Notebook provides new information—including version updates, new test data, long-term usage reports, and reader feedback—on products and product categories.

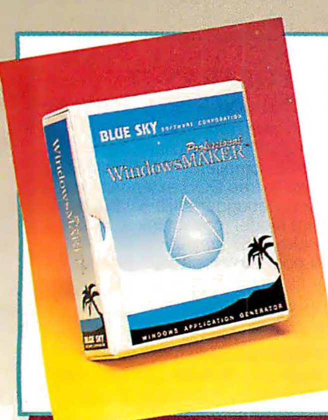
ITEMS DISCUSSED

Infralink .... $320 per unit
Infralink of America, Inc.
1925 North Lynn St., Suite 703
Arlington, VA 22209
(703) 522-4412
Circle 1225 on Inquiry Card.

NCR 3447 ....$45,085
NCR Corp.
Workstation Products Division
1700 South Patterson Blvd.
Dayton, OH 45479
(800) 225-5627
(513) 445-6160
Circle 1226 on Inquiry Card.

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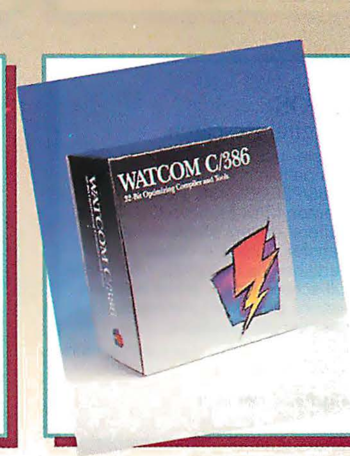
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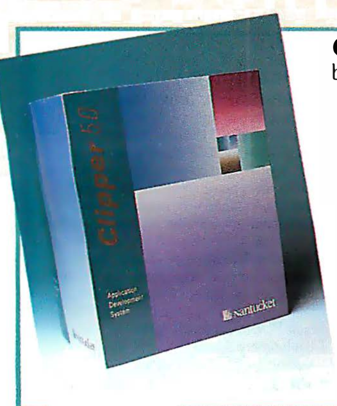
LIST: $995 **PS** Price: **$895**
FastFaxts 2001-006



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by WATCOM

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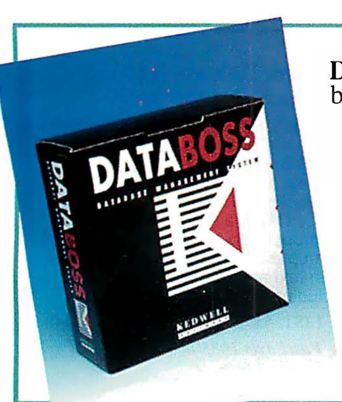
LIST: $795 **PS** Price: **$639**
FastFaxts 1044-020



Clipper 5.01
by Nantucket Corp.

Clipper's open architecture lends unprecedented freedom to application development. Its language is fully extensible with user-defined functions and new user-defined commands. You can extend the language with routines written in Clipper itself, or integrate code from other languages like C, Assembler, dBASE® and Pascal. Develop applications larger than available memory, without defining overlays. Clipper's compiler generates stand-alone, executable files for cost-free, unrestricted distribution.

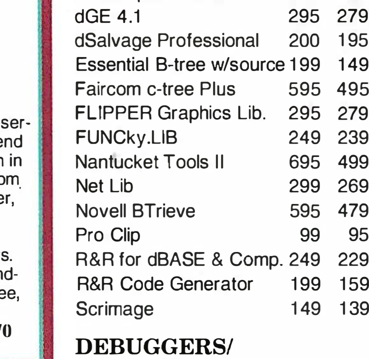
LIST: $795 **PS** Price: **$570**
FastFaxts 1139-003



DataBoss 3.5
by Kedwell Software

DataBoss 3.5 is a complete environment for developing relational database applications and generating Pascal or C/C++ source code. DataBoss has a powerful WYSIWYG report designer and true context-sensitive help throughout. "PC Week" reviewed DataBoss as the most complete database creation system around for the PC.

LIST: $695 **PS** Price: **$649**
FastFaxts 5277-001



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Nantucket Tools II	695	499
Net Lib	299	269
Novell BTrieve	595	479
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R&R for dBASE & Comp.	249	229
R&R Code Generator	199	159
Scrimage	149	139

DEBUGGERS/ DISASSEMBLERS

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Periscope IV	Varies	
Sourcer 486 w/BIOS pre-proc.	170	149
Turbo Debugger & Tools	150	119

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Blinker	299	279
dANALYST Gold	495	100
C-DOC	189	179
Charge	75	69
CLEAR+ for C	200	179
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INSTALIT w/source	249	229
MKS Toolkit	249	229
Optlink	150	139
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GRAPHICS

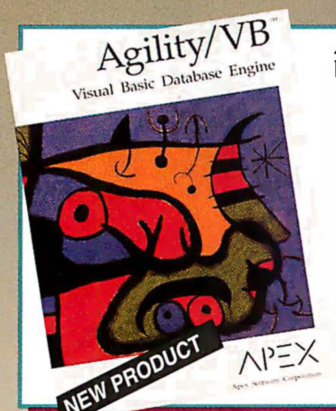
Essential Graphics Chart	399	349
GFX Graphics Library	150	139
GraphiC	465	419
graphics-Menu	249	229
GSS Graphics Dev't Tlkt.	795	699
GX Effects w/Source	399	369
GX Text w/Source	299	289
HALO Professional	395	319
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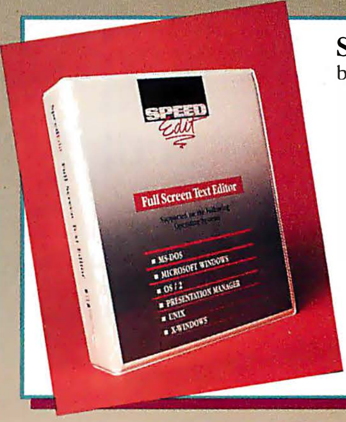


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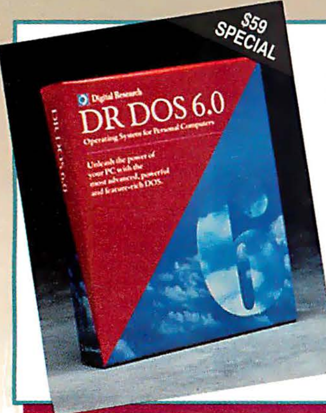


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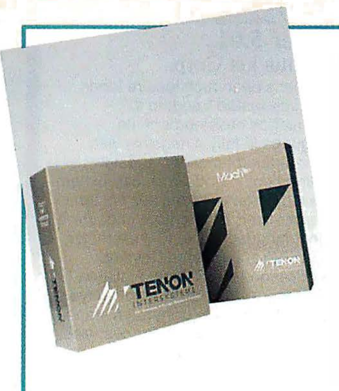
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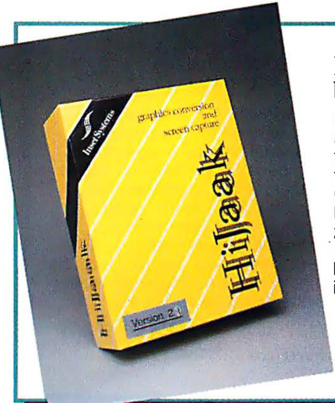


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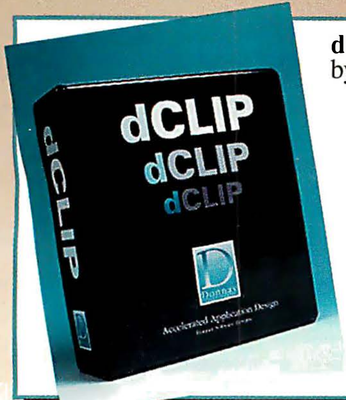
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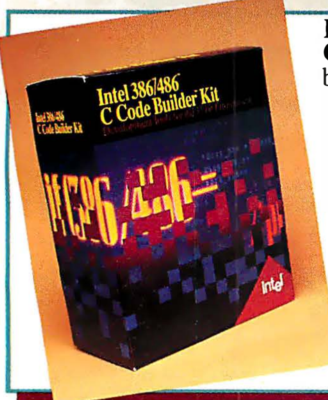


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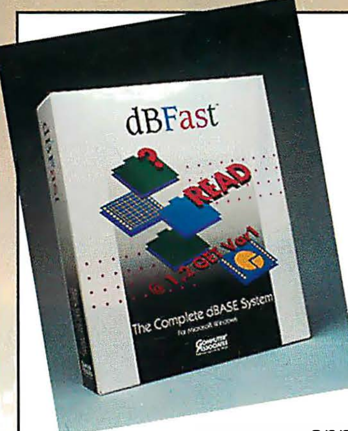


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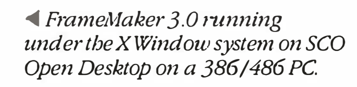
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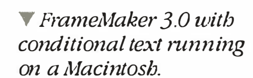
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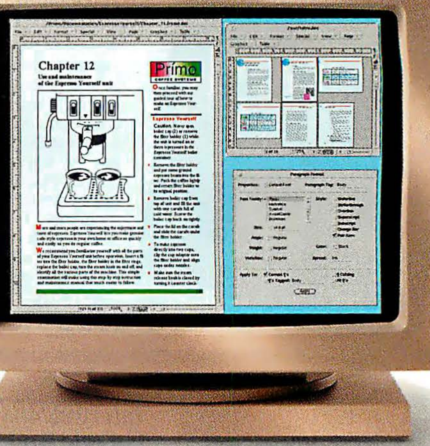
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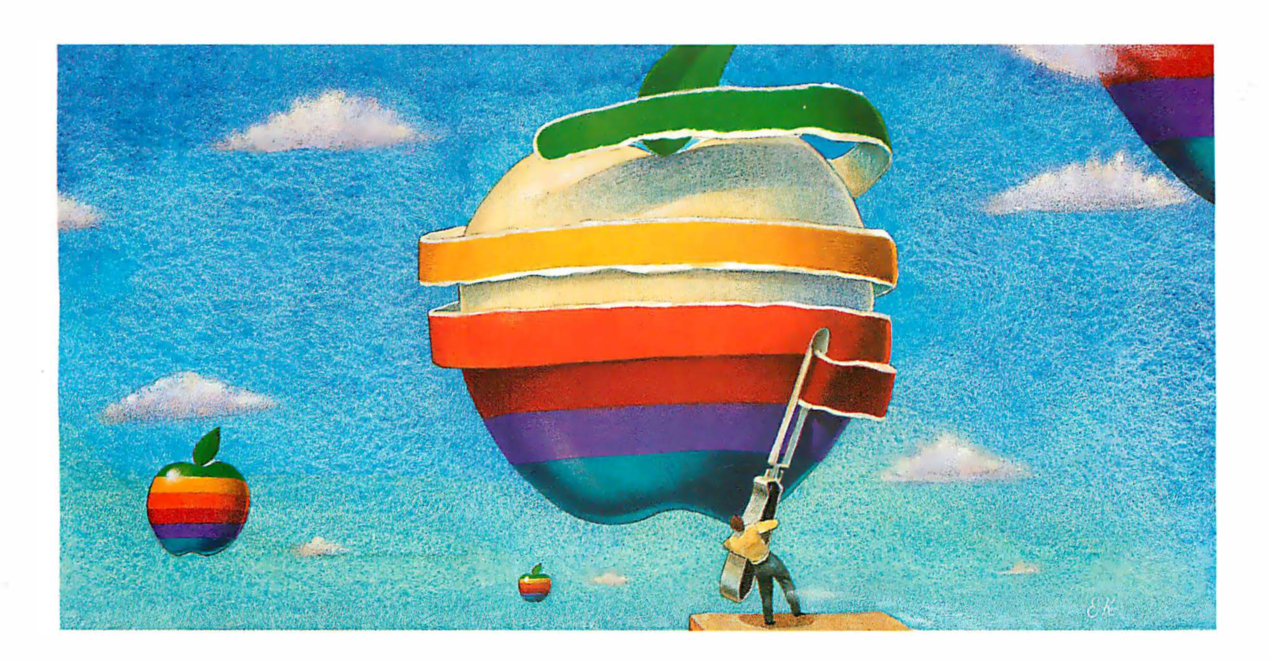




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TOM THOMPSON

MAC PROGRAMMING REVEALED



Programming the Macintosh is not as difficult as rumor has it. Here's how.

The BYTE Lab showed all the telltale signs of a typical late-night programming project. A pyramid of Diet Coke cans had been erected on the lab bench next to the environmental test chamber. The floor was littered with marked-up laser-printed listings and a medley of candy bar wrappers, while a CD player blasted out licks from a Donna Summer disco album. None of these details mattered at the moment. What did matter was the behavior of the sleeping PowerBook 140, sitting under the waiting servos of Thumper II, BYTE's battery-life testing mechanism for notebook computers.

Two bleary-eyed people stared at the testing apparatus: me and Howard Eglowstein, BYTE Lab testing editor and Thumper's creator. Howard had used Thumper to run battery-life tests on the platoon of PC notebooks arranged in neat formation on an adjacent lab bench. I was there to implement the Macintosh version of the support code that had to run on the PowerBooks during their tests. This support code periodically writes to the hard disk to simulate user operations and transmits status reports to Thumper's host computer via a serial cable.

I had started the project on the preceding afternoon and completed the code during the wee hours of the night, but there was still the question of whether the program could function reliably for the many hours the test would run. So far, 5 hours had passed without a glitch. On schedule, a servo whirred, and a rod tapped the notebook's Return key. With an understated pop, the PowerBook's screen came to life, its hard disk hummed, and a message appeared on the host PC's screen. We both breathed a sign of relief.

Somebody wandered in, and, spotting the debris, asked what was going on. I explained that the Mac notebook battery-life tests were under way. When asked how difficult it had been to write the Mac code, my explanation was, "With the exception of some problems with the serial port, it was just a matter of cutting and pasting old stuff into the shape of a battery-check program."

Sound absurd? Admittedly, I wasn't writing a complex application like Wingz, but a lot of Mac programming is like that. To a novice Mac programmer, that raises the question, "Where does old stuff come from?" The old stuff comes from the bits and pieces of code you cobbled together trying to get the Mac to do something—anything—in the first place. These first fumbling steps are the hardest, because there's a lot you have to understand about the Mac environment before you can write a line of code. But it's not impossible, especially if you place limits on what the program should accomplish while you gain an understanding of the computer. What I'll try to do here is show you working code fragments that explain some Mac fundamentals and give you something to start out with in your own programming attempts. But I'll

Listing 1: *A Mac application that writes "Hello world" in a window.*

```
/* Hello world example */
#include <Types.h>
#include <QuickDraw.h>
#include <Windows.h>
#include <Fonts.h>
#include <Memory.h>
#include <Menus.h>
#include <Dialogs.h>
#include <Events.h>
#include <OSEvents.h>
#include <THINK.h>

#define NIL            0L
#define IN_FRONT       -1
#define IS_VISIBLE    true    /* Window will be visible when drawn
                                 (for debug) */
#define NO_GOAWAY     false  /* Window lacks a go-away box */
#define STACK_SIZE    20000

void main()
{
WindowPtr  thisWindow;
Rect       windowRect = {40, 40, 60, 120};

/* Set up application's heap and stack */
   SetApplLimit(((Ptr) ApplicZone() + STACK_SIZE));
   MaxApplZone();

/* Make sure we've got some master pointers */
   MoreMasters();
   MoreMasters();
   MoreMasters();

/* Set up the Mac */
   InitGraf(&qd.thePort);
   InitFonts();
   FlushEvents(everyEvent, 0);
   InitWindows();
   InitMenus();
   TEInit();
   InitDialogs(0L);

/* Make our window */
   if ((thisWindow = NewWindow(NIL, &windowRect, "\pHello", IS_VISIBLE,
         noGrowDocProc, (WindowPtr) IN_FRONT, NO_GOAWAY, NIL)) != NIL)
     {
     SetPort(thisWindow);
     MoveTo(5, 10);
     DrawString("\pHello world");
     InitCursor();                  /* Get rid of wristwatch cursor */
     do                             /* Sit in a tight loop... */
       {
       ;
       }
     while (!Button());              /* ...until mouse is clicked */
     DisposeWindow(thisWindow);     /* Discard storage for window object*/
     } /* end if thisWindow != NIL */
   else
     SysBeep(30);
} /* end main() */
```

start by dispelling some common Mac misconceptions.

A Change of Interface

Rumors have always run rampant that the Mac is hard to program and that it takes hundreds of lines of code to write out the message "Hello world." Interestingly, as Windows 3.0 becomes more popular, the same grumbling can be heard about it as well.

The first myth—that it's hard to program—came about because the Mac, in making things easy for the end user, makes more demands on the programmer. This is because the Mac (and Windows) has an event-driven GUI. The user interacts with the computer by creating events—mouse-clicks, menu selections, and key presses—that the application must respond to. That complicates things for the programmer, who has to anticipate all sorts of user actions at any time. It's not like in DOS or command-line interface–based Unix applications, where you steer users by prompting them for information in a specific order.

To manage this event-driven interface, the programmer implements an *event loop*, which is a chunk of code that polls for events and dispatches them to the appropriate handler code. As you might expect, for sophisticated applications, the event loop and its handler code can be very large, since the loop must field a variety of events and provide reasonable default settings if the user doesn't happen to give them. This also happens to fuel the second myth—those hundreds of lines of code I mentioned earlier.

If you were to implement a full-blown event-driven interface for a "Hello world" application, then this myth would become reality. But look at the matter practically, where you just generate the message itself. Listing 1 is a complete Mac application, written in Symantec's Think C 5.0, that places "Hello world" in a window. As you can see, you only have to write 48 lines of actual C code (excluding comments) to accomplish this. Obviously, the header files supply numerous "hidden" lines of definition code (for a total of 5345 lines, according to the compiler), but that's not the point: You only had to write 48 lines.

By itself, this example doesn't do much: It lacks that event loop I've been talking about. The example shown in all the C primers doesn't do much, either. However, both serve as a starting point for programming basics. Listing 1 illustrates the fundamental operations required to initialize the Mac's graphical environment, open a window, wait for a user action, and then quit cleanly. The Mac's firmware routines, called the Mac *Toolbox*, are used extensively even in this simple program.

Looking more closely, you can see that the Hello application first divvies up the memory partition given to it by the Process Manager (System 7.0) or MultiFinder (System 6.0.x), using the Toolbox call `SetApplLimit()`. This adjusts the application's heap (program area) size, which in turn gives more or less of the memory partition to the application's stack. The default stack size is 8 KB (it varies according to the type of Mac hardware and the Mac OS version number). This size is normally adequate, especially for my example. However, I put the `SetApplLimit()` call there, because if you make heavy use of recursive functions that eat up the stack, you'll want to be aware of it.

Next, you initialize the various Mac Managers. (A Manager is a collection of related Toolbox functions. For example,

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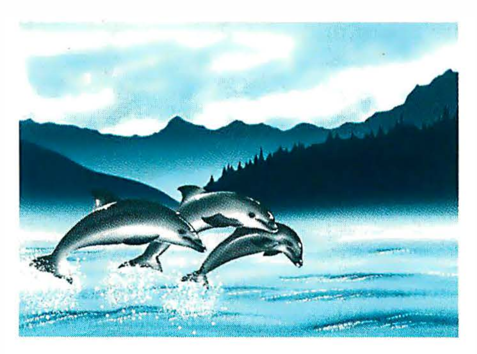
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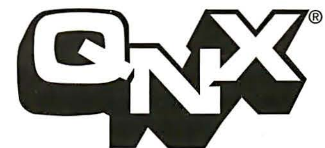


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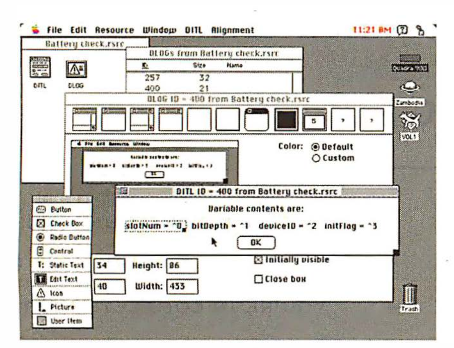
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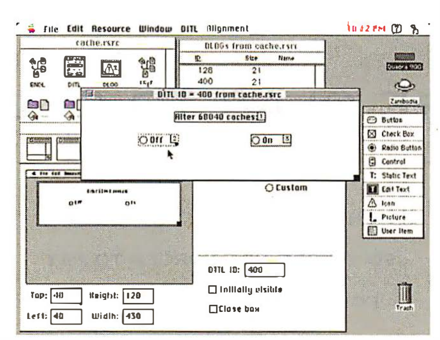
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ARCHITECTURE MAKES THE DIFFERENCE



Screen 1: *Using ResEdit to create a dialog box that displays four values. The digits 0 through 3 will be replaced with value strings at run time. Both the DLOG and DITL resources have an ID of 400.*



Screen 2: *The dialog box used to obtain a choice from the user. A mouse-click on either button supplies an item value to the program. All other events are ignored. Note that this dialog box isn't initially visible; the code displays it later.*

Listing 2: *A diagnostic function that displays the contents of four suspect variables in a dialog box. Note the ID number (400) used by* `GetNewDialog()` *matches the DLOG resource ID built in screen 1.*

```
#include <Types.h>
#include <QuickDraw.h>
#include <Windows.h>
#include <Dialogs.h>

#define DIAGNOSTIC_DIALOG  400
#define NIL                 0L
#define IN_FRONT            -1

void Report_It(long var1, long var2, long var3, long var4)
{
unsigned char  item1Str[10], item2Str[10], item3Str[10], item4Str[10];
short          item;
GrafPtr        oldPort;
DialogPtr      timeDialog;

   NumToString(var1, item1Str);
   NumToString(var2, item2Str);
   NumToString(var3, item3Str);
   NumToString(var4, item4Str);
   ParamText(item1Str, item2Str, item3Str, item4Str);
   timeDialog = GetNewDialog(DIAGNOSTIC_DIALOG,NIL,(WindowPtr)IN_FRONT);
   GetPort(&oldPort);
   SetPort(timeDialog);
   DrawDialog(timeDialog);
   ModalDialog(NIL, &item);
   SetPort(oldPort);
   DisposDialog(timeDialog);
} /* end Report_It() */
```

the Window Manager deals with the manipulation of windows on the screen.) Then you create a window in which to place your message, using the Window Manager call `NewWindow()`. The important thing to note here is the error-checking performed in case the `NewWindow()` call fails: You beep and abort the operation. Next, you tell the Mac OS to make your window the active graphics port using `SetPort()`. (If you don't do this, you may write your message to the Desktop or another window and thus damage the windowing environment.) Finally, you write the string "Hello world" to the window and then hang around waiting for a mouse-click using `Button()`. When you get one, you clean up after yourself and exit.

The linear execution thread of this sample program is identical to that of a DOS or Unix program. Having praised the event-driven design, now I will say something heretical: There's nothing wrong with doing things this way on the Mac. This linear sequence eliminates a lot of messy details while you are learning how the various Managers operate. It's also ideal in certain situations, such as implementing a quick problem-solving hack. I've written a few utilities this way because I only needed to elicit one or two responses from a user to accomplish a task, as you'll see later. If you ever want to write a commercial product (or a great utility), however, you'll need to implement a complete event loop to provide a flexible and friendly interface for the user. For now, I'll stick with the keep-it-simple approach.

Get the Message Out—Carefully

One of the nice things about C is that if you encounter a programming problem, you can slap some strategically placed `printf()` statements in the code to dump the values of suspect variables to the screen. Both Think C and Apple's MPW C support the standard C libraries, so you can use console I/O functions to write to the Mac's screen, and file I/O functions to handle disk files.

You're discouraged from mixing these standard I/O functions with Toolbox calls, and for good reason. Say that you've made a window and you are having problems with the text appearing in it. In an attempt to spot problems, you use a `printf()` function to examine some control variables. What you're really going to see is a bomb box, because the console I/O function will attempt to initialize the Window Manager for its own use, which in turn stomps all over the graphical environment you already set up. Result: The Mac crashes and burns.

This problem applies to other I/O functions, too: If you're using the `fwrite()` function to write to the hard disk, then avoid using Mac File Manager calls at all costs. The trick is to prevent conflicts between what you're actually doing and what the standard I/O functions intend to do. What this means is that you want to use a careful mix of nonconflicting Mac Toolbox calls and standard I/O functions to get the job done.

ResEdit to the Rescue

Back to that troublesome window example. If you can't use `printf()`, then how do you examine the variable data, short of dropping into a debugger? Since you're using the Mac Toolbox already, go an extra step and use the Dialog Manager to display the values. You create a dialog box using ResEdit, Apple's resource editor. Diagnostic code that you write then converts the target variable values to strings and places these strings in the dialog box.

ResEdit is available from the Apple Programmers and Developers Association for about $25. It is also bundled with some development software, such as Think C



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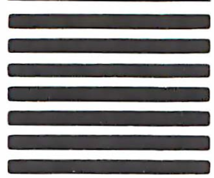
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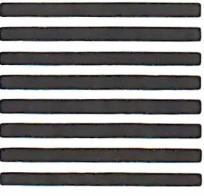
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Listing 3: *A code fragment that sets up a dialog box and then polls for mouse-clicks on items within it. A hit on the appropriate item executes code located in the switch statement. The case constants DISABLE_CACHE and ENABLE_CACHE correspond to the numbered dialog items shown in screen 2.*

```
#define BUTTON_OFF          0
#define BUTTON_ON           1
#define CACHE_DIALOG_ID   400
#define DISABLE_CACHE       2
#define ENABLE_CACHE        3
#define NIL                0L
#define ON_MASK    0x80008000L
#define ON         0x80008000L  /* Both caches are on (bits set) */

void main()
{
unsigned char cacheContents[20];
unsigned long cacheRegister;
short          itemHit;
short          item, itemType;
Rect           itemBox;
Handle         itemHandle;
DialogPtr      theDialog;

/* Initialize the Mac; see listing 1 */
   theDialog = GetNewDialog(CACHE_DIALOG_ID, 0L, (WindowPtr) -1L);
   asm 68030{
      MOVEC  CACR, D0              ;Copy cache-control register
      MOVE.L D0, cacheRegister     ;Save copy in our variable
      }  /* end asm */

   if ((cacheRegister & ON_MASK) == ON) /* 68040 caches enabled? */
      {                             /* Yep; highlight dialog's on button */
      GetDItem(theDialog, ENABLE_CACHE, &itemType, &itemHandle, &itemBox);
      SetCtlValue((ControlHandle) itemHandle, BUTTON_ON);
      GetDItem(theDialog, DISABLE_CACHE, &itemType,
          &itemHandle, &itemBox);
      SetCtlValue((ControlHandle) itemHandle, BUTTON_OFF);
      } /* end if == ON */
    else                      /* Nope. They're off; highlight off button */
     {
      GetDItem(theDialog, DISABLE_CACHE, &itemType,
          &itemHandle, &itemBox);
      SetCtlValue((ControlHandle) itemHandle, BUTTON_ON);
      GetDItem(theDialog, ENABLE_CACHE, &itemType, &itemHandle, &itemBox);
      SetCtlValue((ControlHandle) itemHandle, BUTTON_OFF);
      } /* end else */
   ShowWindow(theDialog);
   DrawDialog(theDialog);
   do /* Handle events */
     {
     ModalDialog(0L, &itemHit);
     switch (itemHit)
       {
       case ENABLE_CACHE:  /* itemHit = 1 */
       asm 68030{
         MOVE.L #ON, D0
         MOVEC  D0, CACR
         } /* end asm */
         ;
       break;
       case DISABLE_CACHE:  /* itemHit  = 2 */
       asm 68030{
         DC.W   0xF4F8  ;CPUSHA BC   — Flush both caches
         MOVEQ #0, D0
         MOVEC D0, CACR
         } /* end asm */
         ;
       break;
       default:
       break;
       } /* end switch */
    } /* end do */
    while ((itemHit < ENABLE_CACHE) && (itemHit > DISABLE_CACHE));
    DisposDialog(theDialog);
} /* end main */
```

5.0. ResEdit has evolved over time to the point where the latest version (2.1.1) makes creating most resources just a matter of pointing and clicking.

Start by using ResEdit to create a new resource of type DLOG and sketching out a window of the desired size. Double-clicking on this window calls up the dialog items (DITL) editor. Now you add static text boxes to display the desired variables, as shown in screen 1. The "caret digit" string in these text boxes tells the Dialog Manager to substitute a string for this position in the window. Be sure to make the OK Button dialog item 1. By default, the Dialog Manager assumes that item 1 is the OK button, which means that you can dismiss the dialog box by pressing the Return key after you've looked at the values. You'll notice that a DITL resource is automatically created when you complete the dialog box design.

Finally, save the resources in a file. For Think C, my support-code project file was named Battery Check. If you name the resource file `BatteryCheck.rsrc`, Think C automatically loads these resources when you test-launch the Mac program. This is very convenient when your program is still in the early stages and you might have to revise the dialog box layout. Once you've completed the resource and code design, you have the Think C compiler create a stand-alone Mac application, where it copies these resources into the application file.

Listing 2 shows the C code that implements the rest of the diagnostic function. This routine takes the four values passed to it and converts them into strings using the Toolbox call `NumToString()`. `ParamText()` then places these strings in the corresponding locations in the dialog box. That is, `ParamText()`'s first argument gets placed at `^0` in the dialog box, the second one is placed at `^1`, and so on. Next, the code has the Dialog Manager create the dialog box (`GetNewDialog()`), set the graphics port, and draw the dialog box's contents. `ModalDialog()` looks for a mouse-click or a key press. When it receives one, it exits, the current graphics port is restored, and you clean up. While this diagnostic function isn't quite as convenient as `printf()`, once you get the resource and diagnostic function code working, it's very handy for debugging work.

A Two-Way Dialog

So far, so good. I've covered how to get a simple Mac application up and running, create windows, and display information using the Dialog Manager. Now, how do you get responses from the user? If you've got the hang of the Dialog Manager, this

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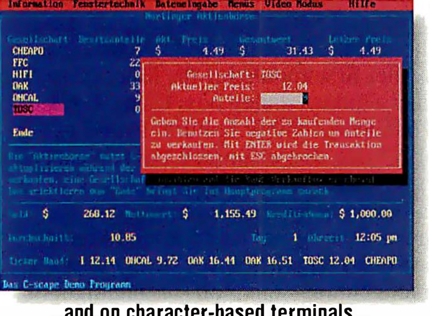
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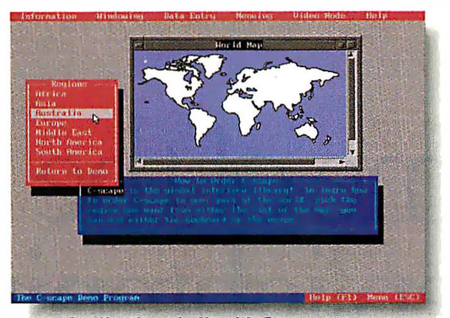


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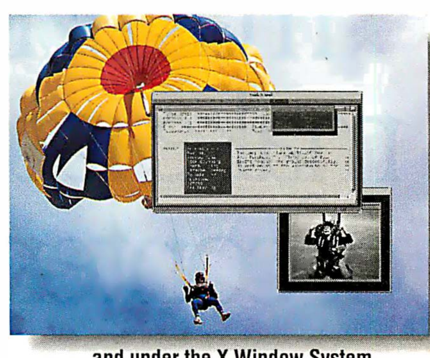


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turns out to be surprisingly easy. The key is understanding the behavior of the just-mentioned `ModalDialog()`. This call presents its namesake, a modal dialog box.

Modal dialog boxes are called such because the Mac is placed into a single mode: No other user events are allowed. If you click outside of such a dialog box, the Mac just beeps at you. You use modal dialog boxes in situations where the user *must* make a choice or supply information that the application requires before it can proceed. When you click on a button or other object in the dialog box, `ModalDialog()` returns the item number of the object that was clicked on.

This behavior has important implications that you can exploit. First, to lock out all other events, `ModalDialog()` implements a sort of mini-event loop that discards all events except those having to do with its window. Second, it returns a dialog item value that you can use in a C `switch` statement to control the execution of your Mac application. By a careful arrangement of buttons, descriptive text, and item numbers for the objects in your dialog box, you can politely prompt the user as to what he or she should do, and then respond to it.

Here's a real example of putting a modal dialog box to work. A while ago, I was involved with running the Mac benchmark test suite on the Mac Quadra 900. Unfortunately, several of these applications crashed on the Quadra, due to side effects caused by the 68040 processor's caches running in the copyback mode. While Apple provides a Cache Control cdev to turn the 68040 caches off or on, you have to reboot the computer for the change to take effect. As fast as the Quadra is, I didn't want to wait for it to restart every time I had to change the operating mode of the caches—not with all the applications I had to run. Looking at a Motorola manual, I discovered instructions that would change the bits in the 68040's cache-control register, which in turn would switch the processor caches on or off.

For this either-or situation, the application design is simple. Screen 2 shows the interface I used: a dialog box with two radio buttons. Listing 3 shows the code that dealt with the interface and handled the job. After first initializing the Mac, I then created a hidden dialog box. Using Think C's in-line assembly feature, I used assembly code that examined the contents of the 68040's cache-control register. This information helps determine whether the caches are on or not, since I might have turned them off previously. The appropriate radio button—on or off—is highlighted to reflect the cache's current status. With the dialog box set up, I used `ShowWindow()` and `DrawDialog()` to make the dialog box visible and draw the dialog items.

The code then called `ModalDialog()` to look for user events. When this call returned, I passed the item value to a `switch` statement. (If the item number isn't either of the radio buttons, the value is thrown away and `ModalDialog()` is called again.) Once I hit a radio button, I executed the corresponding code in the `switch`. I used more in-line assembly code to modify the contents of the cache-control register, exit the loop, and dispose of the dialog box. To flush the 68040 caches before disabling them, I had to manually generate the `CPUSHA BC` instruction that performs this operation.

Amazingly, the code worked the first time. I could disable and enable the caches on the fly and rapidly complete the benchmark tests. I could get away with using these privileged `MOVEC` instructions be-

cause the Mac OS normally runs in the supervisor mode on the Quadra. (It runs in user mode only when virtual memory is active, so the page-faulting mechanism can operate. In this case, I can't control the caches at all.) Not until two weeks later did I find out that by holding the Option key down while using the Cache Control cdev, you could switch the caches on and off the same way. Oh, well...

A Skeleton in the Closet

If you're wondering if the `do` loop and `ModalDialog()` and `switch` statements constitute a rudimentary event loop, you're correct. Obviously, an actual event loop is more complex than this and makes use of other Toolbox calls to capture user events, but if you've grasped the fundamental concept here, then writing a real Mac application is just a matter of filling in the details—a lot of details, to be sure, but it's a manageable task once you've mastered the basics.

Research some of these basics, such as handling menus. If you are stumped on some aspect of Mac programming, be sure to investigate the on-line services or BBSes for snippets of working Mac code. Or, if you know a Mac programmer, ask him or her for information: More often than not, the programmer will be glad to share. Also, lay your hands on the programming texts mentioned in the bibliography.

Writing a full-blown Mac application, event loop and all, is a lengthy process. You may be interested to learn that most of the experts keep a code "skeleton" handy for ready use. This skeleton implements the event loop, menu, and basic file operations. Creating a new Mac application becomes just a matter of fleshing out the code skeleton with task-specific code.

More often than not, even the task-specific code is cut and pasted from other source code files. For example, I have a lot of code files that do useful things, such as displaying a continuous line count in a dialog box, building a hierarchical menu, or initializing a serial port. When it came time to write the battery-life support code, I hauled out a code skeleton that I've developed over the years and began cutting and pasting. Naturally, some detail work required new code. This wasn't too difficult a task, because I could focus all my efforts on writing the new code and trust the old code to take care of the rest.

As I said at the beginning of this article, Mac programming requires diligent work because there are so many details to handle, such as hundreds of Mac Toolbox calls and dozens of data structures. Nevertheless, if you start small and keep your first programming projects simple, you can eventually understand it all—or, at the very least, write a set of files that remembers the details for you. ■

BIBLIOGRAPHY

Knaster, Scott. *How to Write Macintosh Software*. Hasbrouck Heights, NJ: Hayden Book Co., 1986.

Mark, Dave. *Macintosh C Programming Primer: Mastering the Toolbox Using Think C*, vol. 2. Reading, MA: Addison-Wesley, 1990.

Mark, Dave, and Cartwright Reed. *Macintosh Programming Primer: Inside the Toolbox Using THINK's LightspeedC*, vol. 1. Reading, MA: Addison-Wesley, 1989.

Tom Thompson is a BYTE senior technical editor at large. He has a B.S.E.E. from Memphis State University. You can contact him on BIX as "tom_thompson" or on AppleLink as "T.THOMPSON."

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NICHOLAS BARAN

Wireless Networking



New technologies and standards portend the era of mobile computing

One of the most promising and widely discussed technologies of this decade is the wireless network. The idea of computers communicating through radio waves or infrared links is compelling and opens up a wide range of possible new applications for computers. Wireless networks can facilitate warehouse inventory-taking, cooperative learning in the classroom, and countless other tasks that can benefit from mobile networked computing. It's also a key enabling technology for pen- or notepad-based computing systems. But while there is much excitement and enthusiasm about wireless networks, the technology is still in its infancy (much like pen-based computing), and it must overcome a variety of technical and regulatory hurdles before it becomes a major component in today's computer systems. In this article, I'll take a look at the primary types of wireless technologies and their current status.

It is not realistic to expect wireless networks to replace unshielded twisted-pair and other hard-wired networks. Cable offers much higher data transmission speeds than are possible with wireless technology and will continue to do so for the foreseeable future. While most wireless networks offer maximum speeds of about 2 Mbps (many systems, as I will discuss later, are considerably slower than that), UTP systems operate at a minimum of 10 Mbps and are expected to reach speeds of 100 Mbps in the next two years. Fiber-optic (Fiber Distributed Data Interface, or FDDI) cable systems will achieve even faster transmission rates, while wireless networks will reach maximum speeds of only 10 Mbps. Clearly, wireless systems cannot compete with wired networks with regard to performance.

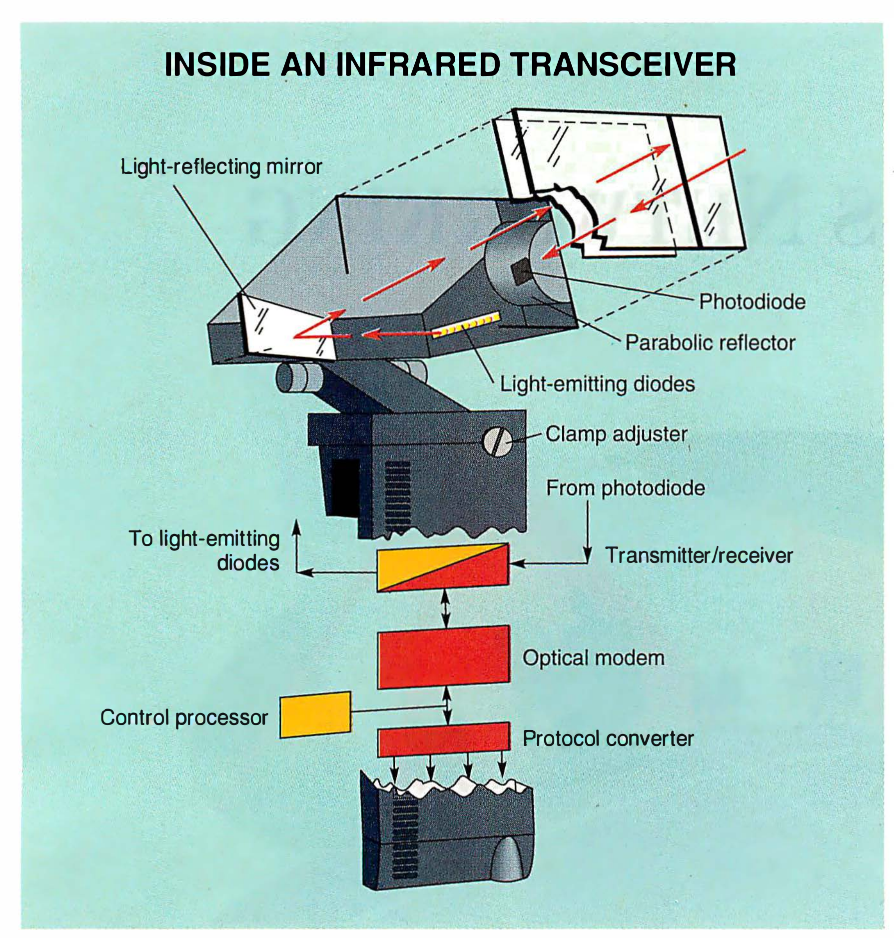
Wireless systems will, however, nicely complement wired networks. According to Ken Biba of Xircom (a network hardware vendor mainly known for its pocket LAN adapters), "wireless will solve your last 10 to 50 meters." In other words, a wired network can serve as a primary, or backbone, system, with a wireless network providing additional mobility.

The Long and Short of It

There are two broad categories of wireless networks: long-distance and short-distance. Long-distance networks are designed to transmit data within a metropolitan area or across a country and are characterized by relatively low data transmission rates, in the 4.8- to 19.2-Kbps range. Short-distance wireless networks are primarily in-building networks with speeds ranging from 230 Kbps to 2 Mbps.

The two primary types of long-distance networks are public and private packet-switched radio networks and cellular-circuit-switched telephone networks. Cellular telephone networks are an expensive means of transmitting data. Cellular modems are much more expensive

ILLUSTRATION: MARTY BRAUN © 1992



The components of the Photonics infrared transceiver. The transceiver directs the beam of light to a passive surface, such as the room's ceiling, where the light transmission can be picked up by another transceiver.

than conventional modems, since they require special circuitry to handle the loss of the signal when the circuit is handed off or switched from one base station to another. This signal loss is not a problem for voice communications because the switch delay, which usually lasts a few hundred milliseconds, is not noticeable to the speakers. But it can play havoc with data.

There are many other drawbacks of cellular data transmission: phone-usage charges can easily add up; cellular transmissions are easily intercepted, which makes data security an issue; interference and transmission errors are a major concern; cellular data transmissions must compete for cellular lines that are already jammed with cellular voice transmissions; and transmission speeds are slow. All these drawbacks make cellular data communication appropriate only for small file transfers or perhaps for short database queries to a host computer. Nevertheless, advances in data compression, data security, and error-checking algorithms will make cellular networks a viable option in some situations. Cellular modems will certainly play a role in wireless fax transmission.

The other major long-distance network option is the public packet-switched radio network. Packet-switched networks do not have the signal-loss problems that plague circuit-switched networks because the architecture is designed to support packets of data rather than voice communications. Note that private packet-switched networks, such as those used by public safety departments, government agencies, and electric utilities, use the same technology as the public variety but on restricted RF bands using an organization's own computer systems.

Public Radio Networks

The public radio network market has two major players: ARDIS, a joint venture of Motorola and IBM, and RAM Mobile Data, a company that uses the Mobitex mobile data network system developed by the Swedish company Ericsson AB. This system is widely used in Europe.

These public radio networks provide a series of radio channels in major metropolitan areas that are licensed by the FCC and are available for a fee to be used as long-distance networks. The user pays a monthly fee for air time and use of the mobile data equipment. The network company (e.g., ARDIS or RAM Mobile Data) provides the network infrastructure, which includes area network controllers and base stations, fault-tolerant computer systems, and so forth. Both these systems support the X.25 packet-switching standard as well as their own proprietary frame-relay packets. (For more on frame-relay packets, see the State of the Art section in the July 1991 BYTE.)

These public radio networks are fully documented according to the Open Systems Interconnection reference model (see "Remote Connections," July 1991 BYTE, for a complete description of the seven network layers that make up the OSI reference model). Both ARDIS and the Mobitex system specify the lower three network layers (i.e., physical, data link, and network) and provide flexibility in the application layers, allowing custom software and applications development. A small company called RF Data (Hinsdale, IL) has developed a data-compression routine for use on these public networks. Hardware developers also provide peripherals for use with public networks. For example, IBM has developed its PCradio for use with ARDIS and other Motorola-based public and private networks. The PCradio is a hand-held device with an 80C186 microprocessor running DOS, a built-in radio/fax/modem, an IC memory card slot, and 640 KB of RAM.

These public networks operate in the 800- to 900-MHz frequency range. ARDIS offers a data transmission speed of 4.8 Kbps, while Mobitex operates at 8 Kbps. Motorola recently introduced a new version of its public radio network technology that operates at 19.2 Kbps in the U.S. (and at 9.6 Kbps in Europe due to a narrower frequency band). The ARDIS system will eventually migrate to this new Motorola network technology.

Public radio networks such as ARDIS and Mobitex will play a significant role in the LAN market, particularly for large corporations with widespread field-service activities. For example, Otis Elevator uses the ARDIS system for its field-service organization. But, as with cellular technology, these networks are limited by their low data transfer rates and are not practical for large file transfers. They are appropriate only for two-way messaging, short-duration transactions, and small file transfers.

WIRELESS NETWORKING TECHNOLOGIES

A comparison of wireless network media. (Table courtesy of Photonics Corp.)

	Public networks	In-building microwave	Cellular modems	Spread-spectrum	Infrared
Speed	4.8–9.6 Kbps	10 Mbps	2.4–16.8 Kbps	0.23–2.0 Mbps	0.23–10 Mbps
Range	Wide area	Building	Wide area	20–100 meters	20–200 meters
Cost per node	$100/mo.*	Unknown	$100/mo.*	$300–$1400	$250–$300

* Monthly charges vary according to usage (these examples are at the low end).

Wireless LANs

Wireless LANs differ from conventional wired networks primarily in the physical and data-link layers of the OSI reference model. The physical layer simply describes the method by which the bits of data are transferred from one node to another. The data-link layer (also called the media access control, or MAC, layer) describes how those data bits are packaged and error-checked. The higher layers generally conform to existing network protocols or use bridges, routers, or gateways to connect to them.

The two methods of implementing the physical layer in a wireless LAN are radio frequency and infrared light transmission. Infrared systems are primarily limited to a single room, since the receiver and transmitter must be able to see each other. There are, however, infrared building-to-building networks in which the transceivers are placed in windows of adjacent buildings.

RF transmissions have one major disadvantage: government regulations over the use of radio frequencies. Currently, there are no RF bands in the U.S. for the exclusive use of wireless LANs other than narrow-frequency bands licensed by private companies (e.g., Motorola or RAM Mobile Data) for commercial applications. The same situation is true for the rest of the world, and, to make matters worse, there are no international standards for RF data transmissions. Therefore, different countries have different regulations and allocate the same frequency bands for different uses. However, efforts are under way to establish an international standard for RF transmissions.

Infrared does not have this problem and is, therefore, an attractive alternative to RF wireless LANs. The principle of infrared data communication has existed for many years. In the late 1970s, Hewlett-Packard introduced its HP-41 calculator, which used an infrared transmitter to operate a portable thermal printer. HP, as well as other manufacturers, uses infrared communications in calculators and other electronic devices. Of course, infrared is used in remote controllers for TVs, VCRs, and stereos. The same principle used in these devices also applies to the use of infrared communication on a wireless LAN: The infrared light is beamed from one transceiver to another, and the light transmission is encoded and decoded at the sending and receiving ends into a protocol compatible with existing network protocols.

The pioneer in the development of infrared networking is Richard Allen, who founded Photonics Corp. in 1985 and developed an infrared transceiver. The first version of this transceiver, developed for end users, directed the infrared beam of light to a passive surface in the room—usually the ceiling—where another transceiver could pick it up. Multiple network nodes can be installed in a single room by using a limited passive area for each transceiver.

To set up a room with infrared transceivers, you simply aim the transceivers at a common spot on the ceiling. A green light on the transceiver illuminates when the alignment is correct. See the figure for an illustration of the Photonics transceiver. To date, Photonics has only developed an AppleTalk/LocalTalk version of this transceiver, called Photolink, that operates at 230 Kbps. The system has a range of up to 200 meters.

Photonics has also developed a miniaturized version of the transceiver for use as an OEM product in laptops and notebooks. This version uses the principle of diffused infrared light, in which the beam of light is diffused throughout the entire room and picked up by other computers or terminals containing infrared transceivers. In addition, Photonics is working on an Ethernet version of its portable transceiver and claims the unit has transmission speeds of up to 1 Mbps.

Prices for the transceiver in OEM quantities start at $20. This makes it an affordable add-on for pen-based or other portable systems.

While Photonics is currently the main player in the infrared market, you can expect other companies to make some moves. BICC Communications (Auburn, MA) has developed a Token Ring–based infrared transceiver that requires you to install a central transmitter in the room. The IEEE 802.11 wireless networking group is currently working on a standard MAC layer for infrared networks.

RF Wireless LANs

In 1985, the FCC allowed unlicensed operation of devices using less than 1 watt of power in three frequency bands: 902 to 928 MHz, 2400 to 2483.5 MHz, and 5725 to 5850 MHz. These frequency bands, called ISM bands, had previously been limited to licensed industrial, scientific, and medical instruments. Network vendors therefore began developing devices for networking within those frequency bands.

Unlike licensed frequency bands, such as those used by ARDIS and Mobitex, ISM bands are open to everybody. To minimize interference, FCC regulations stipulate that a signal transmission technique called *spread-spectrum modulation*, which has a maximum transmitter power of 1 W, must be used within the ISM band. This technique has been used for military applications for many years. The basic idea of spread-spectrum modulation is to take a conventional narrow-band signal and distribute its energy over a much wider frequency domain. Thus, the average energy density is far lower in the spread-spectrum equivalent of the original narrow-band signal. In military applications, the objective is to reduce the energy density below the ambient noise level so that the signal is undetectable. The idea in commercial radio networks is to be able to receive and send signals with minimal interference.

There are two techniques used for distributing the conventional narrow-band signal into a spread-spectrum equivalent: direct sequencing and frequency hopping. In the direct-sequence method, the incoming bit stream is multiplied by a

higher-frequency signal based on a predetermined spreading function. The original data stream can then be recovered at the receiving end by correlating it with the known spreading function. This technique requires a computationally powerful device, such as a digital signal processor, to correlate the incoming signal. Currently, the fastest spread-spectrum device is the NCR WaveLAN spread-spectrum radio, which uses direct sequencing at a speed of 2 Mbps. Current technology allows a range of about 100 meters.

Frequency hopping is a technique in which the receiving and transmitting devices move synchronously in a predetermined pattern from one frequency to another, both hopping at the same time and in the same predetermined sequence. As in the direct-sequence method, the data must be reconstructed based on the frequency-hopping pattern.

While spread-spectrum modulation is a viable method for wireless networking, the current allocation of ISM bands is proving inadequate due to the competition with other devices in these bands. For example, the higher ISM bandwidths (2.4 and 5.8 gigahertz) have microwave ovens to contend with.

Many proponents of various wireless approaches like to point out that competing wireless approaches have big security problems. But, according to Xircom's Ken Biba, security is more of a red herring. Most, if not all, network vendors in the wireless field use some form of data encryption. In spread-spectrum applications, the spread-spectrum function itself is a form of data security. And, as Biba points out, hard-wired Ethernet cables make excellent antennas. In other words, security is probably not any more of a problem with wireless networks than it is with other methods of data communication.

The Data-PCS

The inadequacies of ISM bands have prompted Apple to petition the FCC to establish a dedicated frequency bandwidth for data transmissions, called the Data-PCS (for personal communications service). Apple has requested the FCC to allocate 40 MHz within the 1850- to 1990-MHz bandwidth strictly for data communications. According to the petition, "an allocation of 40 MHz is sufficient to permit several Data-PCS networks operating at rates of up to 10 Mbps, for example, to coexist in the same geographic area today, as well as to motivate technological innovations that can lead to higher data rates in the future."

Apple's petition states that the company performed extensive testing of the current ISM bands using spread-spectrum modulation and found that "there is a strong likelihood of unpredictable, essentially uncontrollable, interference in the ISM bands." Apple's extensive testing also indicated that the 1850- to 1990-MHz frequency band provides the optimum propagation characteristics for data communications.

According to the Apple proposal, the dedicated bandwidth would conform to "Part 15" rules, or, in other words, would continue to require spread-spectrum devices to have a transmitter power of under 1 W. The petition further requests that the FCC require data to be transmitted on the Data-PCS in "packetized form." This requirement is already met by all major network protocols. In addition, Apple's petition requests that manufacturers should have the right to maintain proprietary encryption schemes for data transmitted via the Data-PCS.

The petition also asks that the FCC release 10-MHz increments for the Data-PCS in two-year intervals starting this year. Thus, it will be a slow process before a full-fledged dedicated data radio LAN will be fully functional.

In-Building Microwave

In the meantime, alternatives to unlicensed spread-spectrum modulation are available from private companies such as Motorola, which recently introduced its first wireless in-building network that supports Ethernet LANs at 10 Mbps. Called Altair (not to be confused with the old Altair microcomputer), the system uses a centrally located control module that can support up to 32 Ethernet devices within an office area of approximately 5000 square feet. The Ethernet devices are connected to a user module located on the desktop and transmit data using conventional frequency modulation at 18 gigahertz to and from the control module. While the Altair system provides a wireless solution for the desktop office environment, it does not address the need for *mobile* wireless communications, which spread-spectrum radio and the Photonics portable infrared transceiver do provide.

In the European market, Olivetti has introduced a wireless LAN based on the Digital European Cordless Telecommunication standard. DECT uses a star topology in which each device in the star transmits to the server at a speed of 1 Mbps. The exact frequency range of the DECT LAN has not yet been specified, but it will be in the microwave frequency range using conventional FM, probably around 18 gigahertz. More specific details are expected early this year.

Wireless LANs and Mobile Computing

The table summarizes the different types of wireless networks discussed in this article. As I mentioned earlier, wireless networks will be a key component in mobile notebook and pen-based computer systems. In fact, without wireless networking, much of the utility of a pen-based system is lost. The idea of working in the field with an electronic notepad from which you can query a host database or transmit a fax to the home office is a crucial concept in the pen-based computing model.

Several issues must be considered in the development of wireless network environments. From a software perspective, wireless networks require a different approach than wired networks. In particular, network connectivity can be easily interrupted in a wireless network if, for example, the wireless user walks outside of the range of the radio or infrared signal. Therefore, network software for wireless systems must provide methods for seamlessly detaching and reconnecting to the network without crashing either the network or the remote node. Ideally, the network would be able to interrupt a data transmission and pick up where it left off when the network was reconnected.

Go Corp.'s PenPoint operating system has addressed this problem in its wired networks by incorporating a feature called "detachable networking." By unplugging the network cable, the PenPoint user automatically suspends network operations. Presumably, the same approach would work for wireless systems. Nevertheless, it's unknown how the network server would respond to these interruptions.

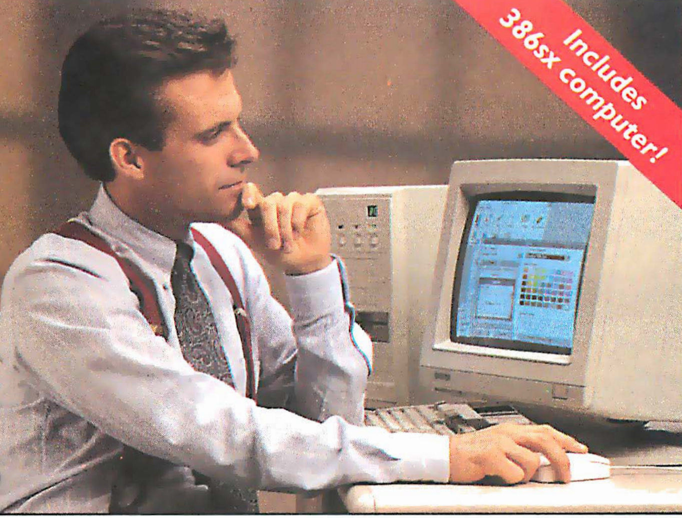
Regardless of the technical challenges that face wireless networking, all will be for naught unless the regulatory challenges are overcome. The FCC must allocate a dedicated frequency band for data communications. As Apple's proposal points out, the current shared usage of ISM bands is simply too unreliable for data communications. In addition, international standards must also be established, allowing U.S. and foreign vendors to be able to design internationally supported wireless network systems. Hopefully, the IEEE 802.11 committee and its foreign counterparts will be able to establish working standards in the near future. In any event, the next few years should deliver some exciting new developments in the field of wireless networking. ■

Nicholas Baran is a consulting editor for BYTE and coeditor of Pen-Based Computing *(Sandpoint, ID). He can be reached on BIX as "nickbaran."*

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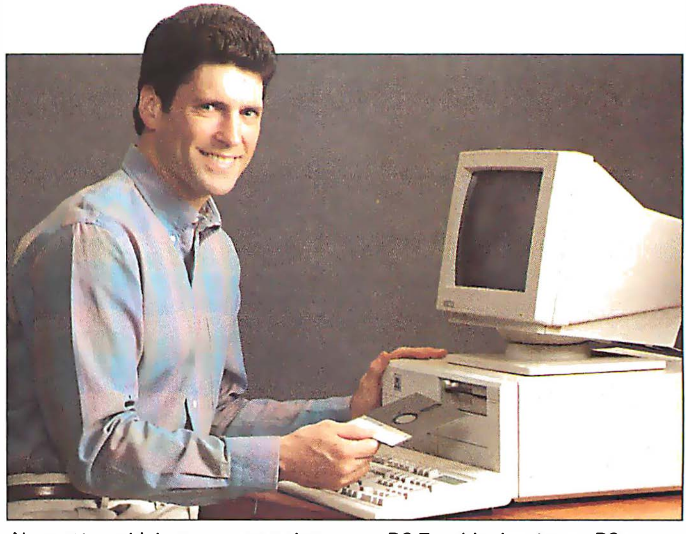
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BARRY NANCE

BATCH-FILE TOOLKIT

These batch-file enhancers extend the capabilities of DOS

I feature three DOS enhancers this month: Need, Get, and Ask. Each adds significant features to the batch-file programs you write. If, like me, you stopped writing DOS batch files long ago out of boredom and frustration, you may find that these utilities rekindle your interest in batch-file programming.

A Friendly Environment

Need, which includes Avoid and Sniff, ensures a friendly hardware and software environment. You can use these three programs to see if Desqview is running; to determine if there's sufficient conventional, extended, or expanded memory; to determine if the CPU is a 386 or higher; or to check for a host of similar conditions. Need includes numerous hardware and software tests to determine if a machine meets all your requirements.

You tell Need what you want. It tests the computer's configuration and sets DOS's ERRORLEVEL variable to 0 if all is OK or to 1 if one or more of the conditions you specified could not be met. You can check the ERRORLEVEL inside the batch file and decide if your batch file should continue, abort, or alert the user.

Avoid is the opposite of Need; it helps you avoid certain hardware/software combinations. Finally, Sniff will return configuration information that you can read.

What DOS Leaves Out

Get supplements the DOS batch-file commands. It turns batch-file programming into macro-language programming. Like Need, Get queries the hardware and software configurations of a system. However, Get also prompts for input and sets system parameters. This utility can ask questions, get disk and file information, get hardware or software information, do screen output, and toggle system settings.

Get's command-line parameters let you get and put strings; set screen color and video mode; and get the DOS version, file size, free disk space, disk size, current directory, and volume label.

Typically, Get sets an environment variable that you can test after Get completes. For example, you might code the following

```
GET N "Answer yes or no: "
IF "%GET%"=="N" goto NO
IF "%GET%"=="Y" goto YES
```

to get a yes or no answer from the person running your batch program.

Just Ask

Use Ask to get multiple-choice answers to questions you submit to the user. Ask puts a string in the master environment containing the user's answer, and you can easily test the string to know what to do next in your batch-file program. You can even use Ask to build menus inside batch programs. You might use Ask to determine which program to launch, or to force a compiler or linker to use a certain set of options or libraries.

You can use Roedy Green's Need, Avoid, and Sniff for free, but you must pay the $15 registration fee to get the assembly language source code. Get is a $15 shareware program developed by Bob Stephan. Ask, written by Jay Vanderbilt, is free. ■

UNIX/Ben Smith

Noninteractive Unix

Computing implies automation. But since the advent of interactive programs, where users control the program as it runs, the ability of a program to run noninteractively (i.e., in batch mode) has sometimes been neglected by programmers. This trend has even infected the Unix software world, where traditionalists have usually ensured that their programs (e.g., `mailx`) can run both interactively and in batch mode.

To patch some of these holes that liberal-minded developers have created, Don Libes developed `expect`. This utility program performs programmed dialogue with those trendy, user-interactive programs that haven't been designed for use in a world of automation. This is a public domain program. Libes, who works for the National Institute of Standards and Technology, is the coauthor of *Life with UNIX: A Guide for Everyone* (Prentice-Hall, 1988).

MAC/Tom Thompson

Solving Virus Crimes

A computer virus is one of those subjects you'd rather not hear about—until one "roaches" your Mac's hard drive, taking the day's work with it. Worse, like their biological counterparts, new viral strains appear that bypass protective detection software that's only familiar with existing viruses.

Virus Detective 5.0 by Jeffrey Shulman is a $40 shareware desk accessory that scans hard drives and floppy disks for viruses. What's important about Virus Detective is its programmability: You can type in new code signatures so that Virus Detective will recognize new viruses. Virus Detective can read text files with new code signatures. Thus, an update is often only a matter of logging onto an on-line service and downloading the latest signature file. Virus Detective's programmability ends the arms race between the virus creator and victim once and for all—not a bad bargain.

Editor's note: *Software Corner highlights public domain, freeware, and shareware programs. The programs are available on BIX (in the sw.corner conference), from Demolink, and on disk. See "Program Listings" on page 5 for details. We solicit contributions and pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

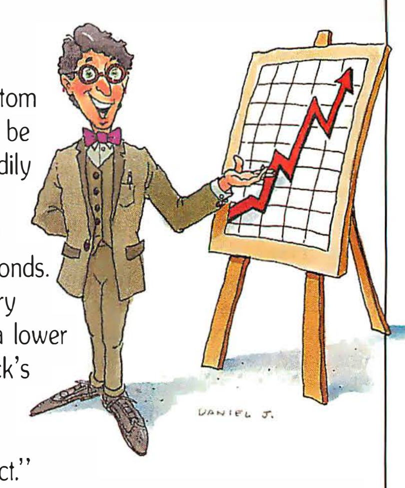
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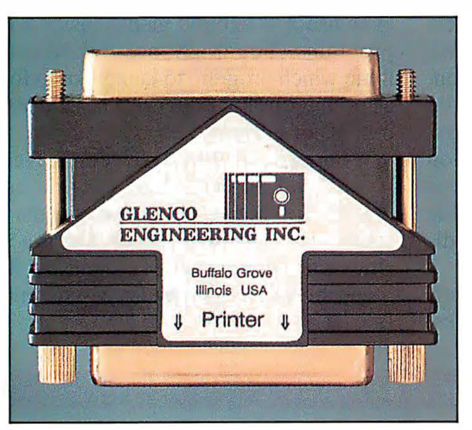
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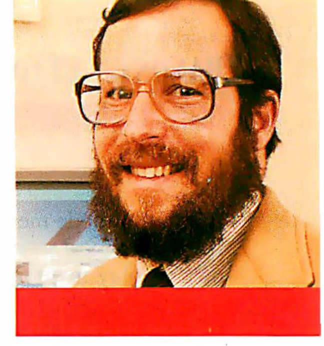
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MARTIN HELLER

INSIDE 386 ENHANCED MODE

Windows is divided into three parts: the kernel, the user, and the Graphics Device Interface (GDI). Although that's the basic architecture, there is more to heaven and earth than is dreamt of in this philosophy. Windows also acts as a DOS extender (DOSX) to work in protected mode.

Most Windows programmers are unfamiliar with DOSX because its documentation is in the Windows Device Driver Kit (DDK). Most programmers have their hands full learning the Windows application programming interface (API), as explicated in the Software Development Kit. I'll try to remedy this.

Standard mode and enhanced mode have quite different DOS extenders. Standard mode works in the protected-address segmented 16-bit mode of a 286 CPU; extended mode sets up 386 virtual machine environments underneath a paged 32-bit virtual machine manager (VMM). Standard mode is really pretty simple; enhanced mode is not simple at all.

Virtual Concepts

What is a virtual machine? Imagine you are a program. You think you have control of a computer, but you don't: The operating system has simulated a computer to fool you. You can't affect programs running in other VMs; you can't even tell they're there.

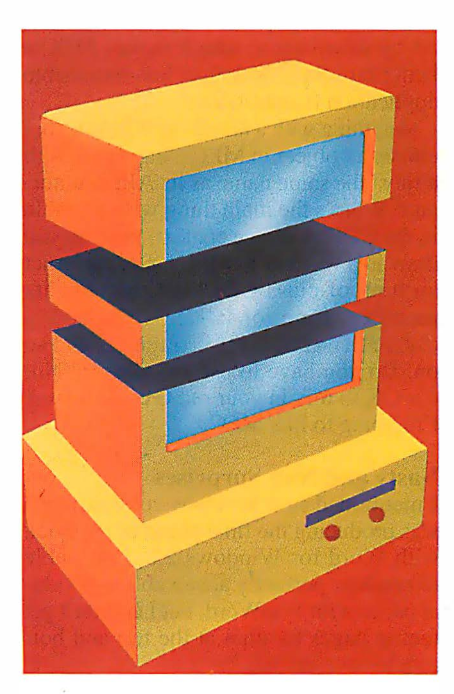
The enhanced-mode Windows implementation of a VM has a memory partition (i.e., an area to save processor registers) and a control block (i.e., data structures to implement virtualization of the other aspects of a PC, such as ports, I/O controllers, DMA controllers, video interfaces, and interrupt tables). In other words, a VM maintains a complete description of the state of an application and lets a program execute as though it were running on a 386 in real mode.

An ordinary real-mode program will be fooled by a VM. A somewhat more sophisticated program will detect that it is running under enhanced-mode Windows using an INT 2F hexadecimal service and, perhaps, modify its behavior to allow for better multitasking. The most sophisticated programs know they are running in a VM and can take advantage of it, using INT 33h services to access the DOS Protected Mode Interface and INT 2Fh services to access other enhanced-mode services. With DPMI, an application can even go into protected mode.

Not every extended-DOS application is compatible with DPMI. But the major DOS-extender vendors—Phar Lap Software, Rational Systems, and Ergo Computing—have updated their products to work with DPMI.

The system VM is automatically created when enhanced mode initializes. It always has a protected-mode portion that is used to run the Windows desktop. Yes, that's right: What you think of as Windows is running in a VM. The Windows desktop, too, is fooled into thinking it has the whole machine, when it is just the first of many VMs.

Things your mother never told you about Windows



Below all the VMs is a VMM, which takes care of allocating memory, CPU time, and peripherals. The VMM and the virtual device drivers (VxDs) run in one flat-model 32-bit memory segment. To write VxDs, you need to write 32-bit programs; 32-bit versions of Microsoft Macro Assembler and Link come with the DDK for that purpose. Windows comes with VxDs for the screen, keyboard, mouse, and serial ports, as well as virtualization support for lower-level hardware.

VM Details

When enhanced mode starts up, VMM and the virtual devices specified in SYSTEM.INI load. The VMM and all the VxDs initialize, the system VM is created and initialized, and, finally, the shell VxD executes Windows. The shell VxD calls V86MMGR services to set up VMs. To start a DOS VM, it uses `V86MMGR_Allocate_V86_Pages` to allocate memory pages for the VM's base memory and map them into the VM. Then it uses `V86MMGR_Set_EMS_XMS_Limits` to allocate memory pages for EMS and Extended Memory Specification and connect those pages to the code that handles EMS and XMS interrupts.

A value of 0 for the minimum and maximum size (normally set in a program information file) will disable access to EMS or XMS services; a value of -1 will set no limit. For instance, setting EMS memory for a FoxPro application to a minimum of 1024 and a maximum of -1 means that the database will see as much expanded memory as possible, at least 1 MB, or the application won't run.

What about having multiple DOS VMs?

continued

In its V86-mode memory map, each VM has its own local set of interrupt vectors, its own display memory, and its own local application code and data. Each also has a map to global memory regions that hold MS-DOS and the loaded DOS device drivers, any network and TSR program code loaded before Windows starts, a portion of Windows/386, and the system ROM. All the above run at privilege ring 3 (the lowest level).

The protected-mode portion of a VM runs at privilege ring 1, 2, or 3. Every VM also has a control block and a client stack at privilege ring 0 (the highest level). The control block contains, among other things, data used by the system VxDs to maintain the state of, for example, the physical hardware across all VMs.

The enhanced-mode Windows VMM has a two-level scheduler that preemptively allocates time among the VMs. The primary level of the scheduler scans the execution priority of all VMs and lets the VM with the highest priority run. The secondary level is the time slicer, which dynamically alters the execution priorities of VMs based on the current time and their foreground and background time-slice priorities.

A VM lets a program execute as though it were running on a 386 in real mode.

When application code in a VM issues a software interrupt or causes a protection fault, the 386 protection mechanism causes a privilege-ring transition. Control transfers to the VMM, which, in turn, dispatches the interrupt to the appropriate VxD. If your program issues a DOS call (e.g., INT 21h), the software interrupt will cause a privilege-ring transition. Instead of directly executing the DOS function, the program flips into the VMM, which makes sure that the DOS function is allowed before it passes control to DOS.

There's much more to enhanced mode, but that's the gist of it. You can find out more from the DDK and by poking around with an enhanced-mode debugger (e.g., Soft-Ice for Windows).

Class Libraries, Redux

My collection of class libraries for Windows continues to grow, with something old—Glockenspiel's CommonView 3.0—and something new—the Microsoft Foundation Classes (MFC). CommonView, which is distributed in the U.S. by ImageSoft, supports Borland C++ as well as Glockenspiel's own C++ translator coupled with Microsoft C 6.0ax. It targets Windows, Presentation Manager, and OSF/Motif in a portable way. CommonView's classes cover the user (i.e., window and dialog-box management) and GDI (i.e., graphics) parts of Windows fairly well. Borland's ObjectWindows covers the user but not the GDI. CommonView comes with container classes and a memory management dynamic link library.

MFC, which ships with Microsoft C/C++ 7.0 for Windows, covers most of the Windows API, including hard parts like Multiple Document Interface and Object Linking and Embedding. MFC has container classes that can also be used in DOS applications, but its main purpose is to encapsulate the Windows C interface. You want portability? It's portable only as far as the Windows API is portable, but the Windows API could go places you'd never have expected. Stay tuned.

MFC is a thin layer. There's relatively little overhead and relatively little abstraction. The MFC sample applications seem as quick as their C counterparts. At the same time, many of the MFC classes were designed specifically to be extended by inheritance, which makes MFC a better building block than less-extensible application frameworks.

Anything with a handle in Windows becomes an object in MFC—an object with almost the same name as its API counterpart. What's the main thing with a handle in the GDI? A device context. How do you draw in a window in MFC? You construct an item of class CDC and then use its member functions: `CDC::MoveTo`, `CDC::LineTo`, `CDC::TextOut`, and so on. Do you have to use the classes? No; it's OK to mix in your old C code. I think I'm going to like MFC.

Nasty and Nice Surprises

I mentioned in a previous column that I was producing the final pages of my book with Word for Windows 2.0. I was able to produce perfectly acceptable individual pages with WinWord, but I couldn't get facing pages to align at the top and bottom to save my life.

Fine, I thought. I'll just flow the book into PageMaker. After all, I'd tested for this possible exigency with Word 1.1. Microsoft wouldn't dare break such an essential function in a new version.

Wrong. PageMaker 4.0 can't import WinWord 2.0 format, nor can it import WinWord 2.0 Rich Text Format output. I tried sending RTF to the Mac. I was able to get Mac PageMaker to read the files only by first opening and saving them from MacWord. My text came across, but none of my illustrations survived the process.

As it happened, there was a copy of Image-In-Color in my pile of things to examine. It produces TIFF files acceptable to Mac PageMaker. I copied all the bit maps out of my WinWord files, saved them as BMP files (using the Image2 application from my book), and then converted each BMP file to TIFF with Image-In-Color.

Happy ending: The book got to the printer complete with all its illustrations, albeit a few weeks later than I had hoped. My apologies to anyone who scoured bookstores looking for a copy of it in early January. ■

Martin Heller develops software and writes about computers, despite a Ph.D. in physics and despite having worked, literally, as a rocket scientist. He is the author of Advanced Windows Programming *(Wiley, 1992).*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

ITEMS DISCUSSED

Glockenspiel's CommonView 3.0 .... $499
ImageSoft, Inc.
(516) 767-2233
Circle 1146 on Inquiry Card.

Image-In-Color $495
Image-In, Inc.
(612) 888-3633
Circle 1147 on Inquiry Card.

Microsoft C/C++ 7.0 for Windows $495
Windows 3.0 Software Development Kit $500
Microsoft Corp.
(206) 882-8080
Circle 1148 on Inquiry Card.

Soft-Ice for Windows $386
Nu-Mega Technologies, Inc.
(603) 888-2386
Circle 1149 on Inquiry Card.

ASK BYTE



Video Downsizing

I want to obtain a high-performance PC on a moderate budget. These systems often include 1024- by 768-pixel monitors that are compatible with standard VGA but not with older video graphics standards (e.g., MDA, CGA, and EGA). I am interested in a video adapter capable of displaying these older video modes.

Do video controllers supplied with high-resolution monitors typically support the older standards? If so, could I simply unhook the high-resolution monitor, configure the video software drivers to older modes, and plug in another monitor?

Thomas A. Williams
Waterford, MI

ATI Technologies (3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2, (416) 756-0718; fax (416) 756-0720) has just the video adapter for you. While many high-resolution video boards let you run EGA- or CGA-mode programs on your VGA monitor, they do not give you dual connectors so that you can attach an EGA or a CGA monitor. The ATI VGAWonder XL gives you 15-pin (analog) and nine-pin (digital) video connections and a mouse port as well. The board supports resolutions of up to 1024 by 768 pixels, as well as VGA, MDA, EGA, and CGA modes. ATI's suggested list price is $399 with 1 MB of video RAM, but you can find it for considerably less.

Many clone vendors will build a system to your specifications and will be happy to substitute the VGAWonder XL for their standard video board.—Stanford Diehl

Windows Environment Revisited

In the October 1991 Ask BYTE, Paul M. Smith brought up a common problem in the DOS community: Running a batch file that sets an environment variable in a DOS window produces an "Out of environment space" error message. The cause of this problem and the fix, however, have little to do with the `windir` variable produced by Windows 3.0.

When started, Windows inherits an environment equal to the parent's current environment. This includes the variable set and the size currently used. Setting an environment size in CONFIG.SYS (e.g., `SHELL=C:\COMMAND.COM /P /E:256`) is the first step. This gives the initial environment a size of 256 bytes. The environment can grow to 256 bytes, but once you start a program, its inherited environment size is limited to what is currently used. The only fix is to add the `/E:256` switch to the COMMAND.COM in Windows.

If you open a DOS window or start a batch file without a program information file (PIF), change the command line under program item properties to `C:\COMMAND.COM /E:256 [/C batchfile.bat]`.

If you use a PIF, set the program filename to `COMMAND.COM` and change the optional parameters to `/E:256 [/C batchfile.bat]`.

Both options start up COMMAND.COM with an initial environment size of 256 bytes. You can change the environment size to any value between 160 and 32,768.

This problem is inherent in nearly all programs that have a shell to DOS or DOS window function (Desqview somehow avoids it). The fix is the same in all cases (provided that the program lets you change the shell/window command). It would be nice if developers would check for the initial environment size setting and use it in their shell/window function.

Here's one little memory-squeezing tip: When loading TSR programs in your AUTOEXEC.BAT file, do so before setting an environment variable (e.g., PATH or APPEND). Because a TSR also inherits the current environment, keeping it as small as possible saves a few precious bytes of memory. The exceptions are those "intelligent" TSRs that release the unneeded environment back to the memory pool.

Kevin J. Burkholder
Spring City, PA

The Working Font

I use Adobe Type Manager and a Qume ScripTen PostScript printer. I have 13 fonts to use with ATM. I wanted to add more fonts using the WFN Boss utility included with CorelDraw 2.0. The utility converts fonts from Corel format to Adobe Type 1 format.

I converted many fonts with WFN Boss. When I used ATM to add these new typefaces, it did so perfectly. But when I tried to print a PageMaker file, all the fonts I had converted printed in Courier. How can I use the fonts converted by WFN Boss to work with other Windows applications?

Jean Lauzier
Val-Brillant, Quebec, Canada

Corel has made improvements to the WFN Boss utility in CorelDraw 2.01. Register your software if you haven't done so and ask for the upgrade.

It also sounds like you have not made some necessary modifications to your WIN.INI file. ATM assumes that typefaces are resident in your PostScript printer. Thus, it does not automatically download them for you. You must do it manually from the WIN.INI file. Load the WIN.INI file into your word processor and find the section where Windows lists the information on your PostScript fonts. The section will begin with the header `[PostScript,LPT1]` *or something similar. You will want to edit the lines beginning with* `softfontX=` *to include the typefaces you have created. The lines will show a path to only the .PFM files. Go to the end of the line, insert a comma, and add a path to the .PFB files. The final result will look something like the following:*

```
softfont9=c:\psfonts\pfm\newfont.pfm,
c:\psfonts\newfont.pfb
```

Also, try using ATM's PSDOWN utility to automatically download the font to your printer. PSDOWN flushes

ı your printer's memory after each print job. If you don't use it, you'll have to reset your printer after each job to free up memory.—Stanford Diehl

High-Resolution BASICs

I recently purchased a 25-MHz 386 computer with a Super VGA card (1024 by 768 pixels) and DOS 5.0. I wanted the higher resolution to program some graphics and animation. I want to work in BASIC and access this high resolution. So far, I have been unable to find out how to do this.

I am able to program in 640- by 480-pixel resolution. I can set the high-resolution mode in DOS (with the display card's DMODE utility), but BASIC sets it back to the lower resolution. Is it possible to have BASIC access the higher-resolution modes?

R. A. Fischer
Sun Lakes, AZ

It's a funny thing about standards—just when you get used to one, someone changes it. Versions of BASIC (and libraries for most other languages) usually support only the modes defined by IBM. That means 16 colors in 640- by 480-pixel mode or 256 colors in 320- by 200-pixel mode. There is a relatively small number of de facto Super VGA standards. The Tseng Laboratories 3000 and 4000 chip sets are popular among manufacturers, as are the sets used by Paradise, ATI Technologies, and Video Seven. To access the higher-resolution modes, you need a replacement graphics library that supports your video card.

You might contact Genus Microprogramming (2900 Wilcrest, Suite 145, Houston, TX 77042, (800) 227-0918 or (713) 870-0737; fax (713) 870-0288) and ask about its GX Effects library ($199). It links into Microsoft QuickBasic 4.x or BASIC PDS 7.x and gives you sprite animation, sound, music playback, Sound Blaster file playback, and many other features. You might also want Genus's $249 PCX Programmer's Toolkit if you're working with .PCX files.

The current versions of both Genus products support the Trident, Paradise, ATI, and Video Seven cards in 800- by 600-pixel display modes, and cards based on the Tseng Labs 4000 in 1024- by 768-pixel mode. New versions (possibly available by the time you read this) will support all these cards and the Video Electronics Standards Association specification in 1024- by 768-pixel mode.—Howard Eglowstein

Resolving Conflict

If Cliff Millward's ScanJet/video board conflict is like mine (Ask BYTE, December 1991), he can cure the problem by changing video boards. When I added a ScanJet Plus a few years ago, my Paradise VGA Plus 16 from Western Digital Imaging would no longer work in 16-bit mode. According to Hewlett-Packard and WDI, the video and scanner interface boards compete for the same memory area. I replaced the Paradise board with an Orchid Technology ProDesigner Plus, which runs in 16-bit mode and politely avoids trampling scanner memory.

I have just replaced the ProDesigner Plus with an Orchid Fahrenheit 1280, and it runs correctly in 16-bit mode with the ScanJet Plus active. I suspect that Orchid's popularity with the graphics crowd, who are likely to use a scanner, caused the firm to design its boards this way. (Contact Orchid Technology, Inc., 45365 Northport Loop W, Fremont, CA 94538, (800) 767-2443 or (510) 683-0300; fax (510) 490-9312.)

David Ellis
Torrance, CA

CNS on the Move

In the August 1991 Beyond DOS, Martin Heller discussed CNS's C++/Views software. I have been unable to locate the company.

Stacey Wohleber
Huntsville, AL

CNS has moved. Its new address is 1250 Park Rd., Chanhassen, MN 55317, (800) 843-2978 or (612) 474-7600; fax (612) 474-6737.—Raymond GA Côté

CPU Upgrade Issues

I have an IBM PS/2 Model 50 Z. I want to upgrade my system to a 386 processor, but I have found some problems in doing so. In Chile, we do not have as much information about products coming to market.

IBM of Chile has an Aox card to upgrade my system, but it is very expensive. The 25-MHz MicroMaster 386 sells for $2000. I know there must be other cards. Can you provide me with the names of manufacturers? I would also appreciate references to any articles published on this topic.

Julio Rodiño Durán
Santiago, Chile

Installing upgrade boards into 286 systems is complicated and expensive. Do so only if you are an experienced user. BYTE has not evaluated any 386DX upgrade boards, but we have covered 386SX upgrade boards (see "SX Upgrade Boards: Not for the Fainthearted," April 1991 BYTE). We also covered two SX upgrade boards in the October 1991 Reviewer's Notebook. One of them was the SX/Now, a product for the Model 50 Z from Kingston Technology Corp. (17600 Newhope St., Fountain Valley, CA 92708, (714) 435-2600; fax (714) 435-2699). The 25-MHz SX/Now upgrade sells for $625.

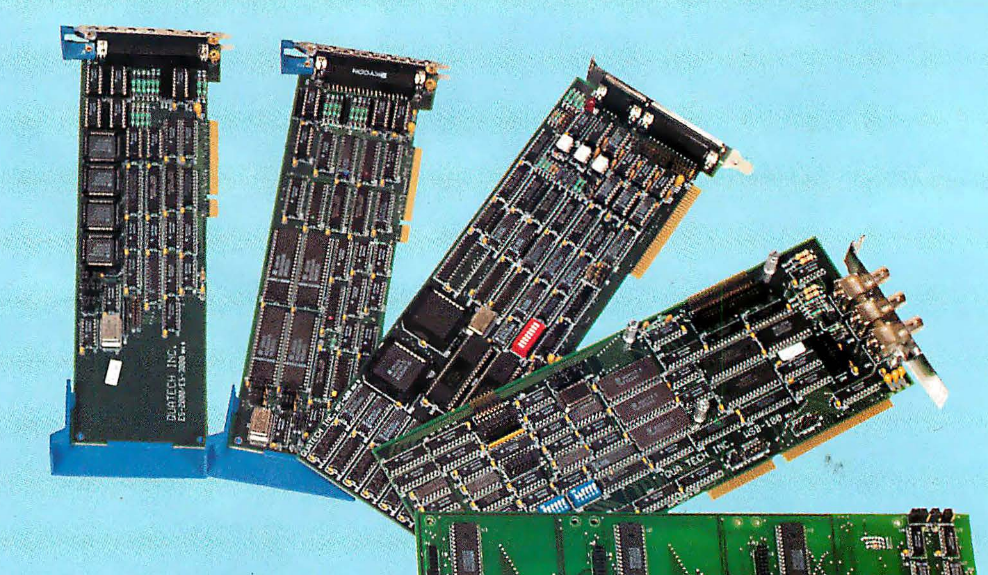
As you mentioned, Aox (486 Totten Pond Rd., Waltham, MA 02154, (617) 890-4402; fax (617) 890-8445) offers the 25-MHz upgrade for your system. It has a list price of $1549. You should also consider 20-MHz versions from both of these companies. You'll give up some performance but save money.—Stanford Diehl ■

The BYTE Lab welcomes your questions. Address correspondence to Ask BYTE, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send BIX mail c/o "editors."

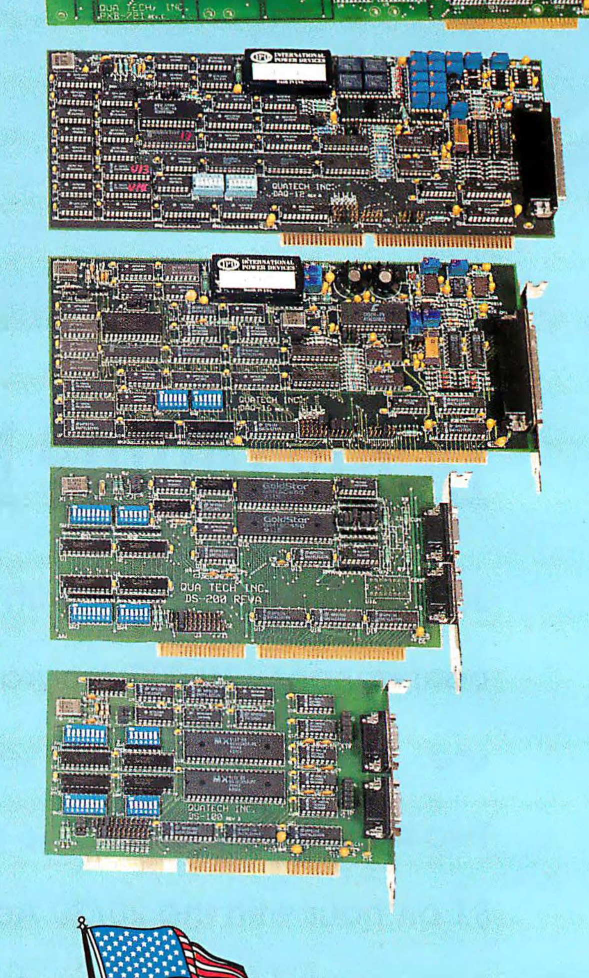
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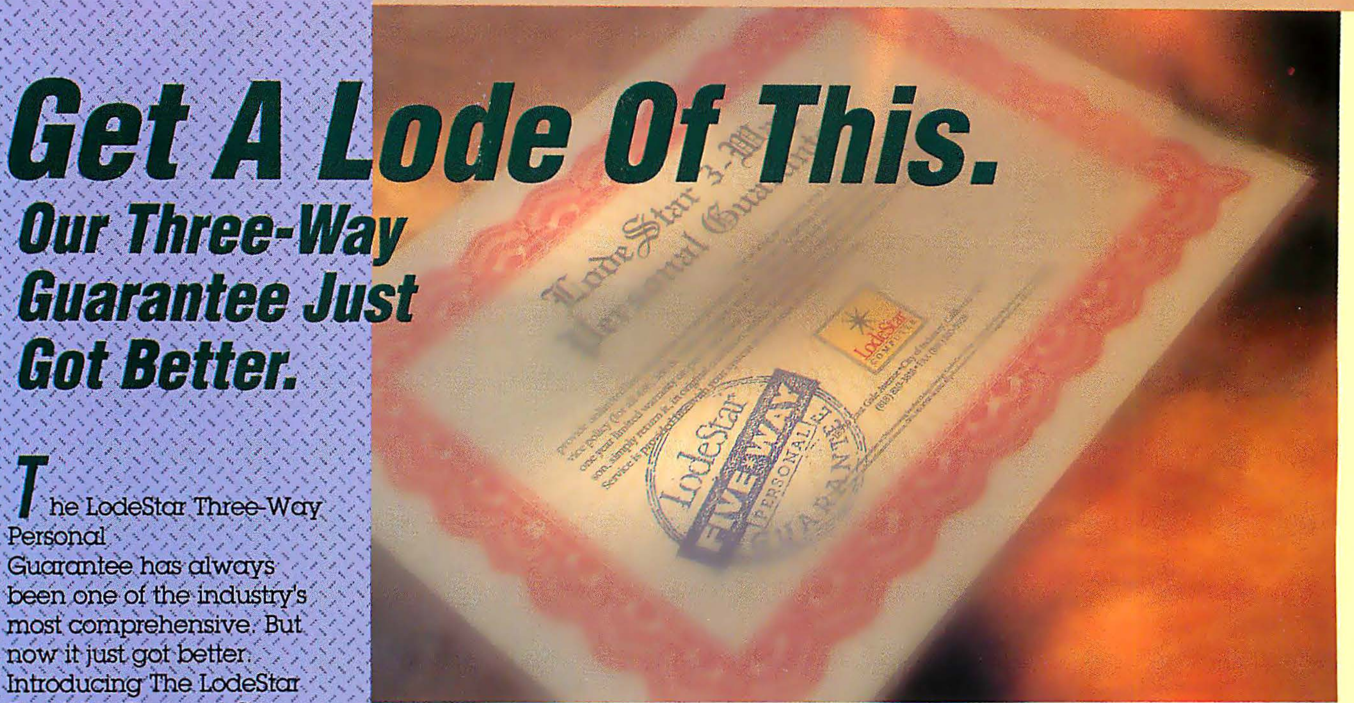
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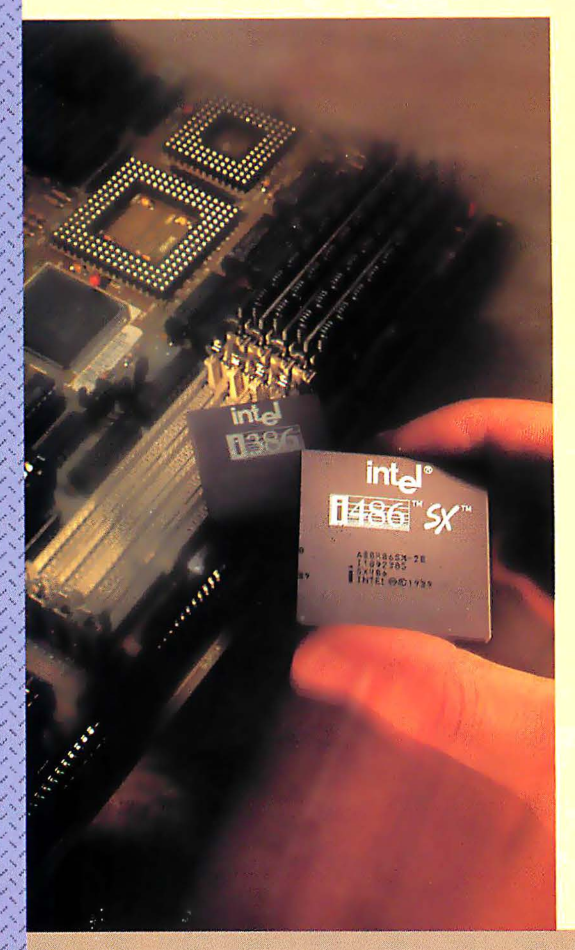
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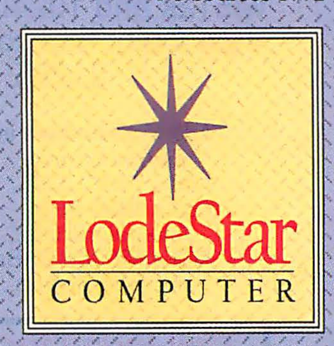
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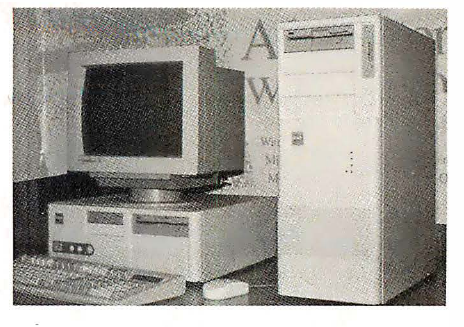
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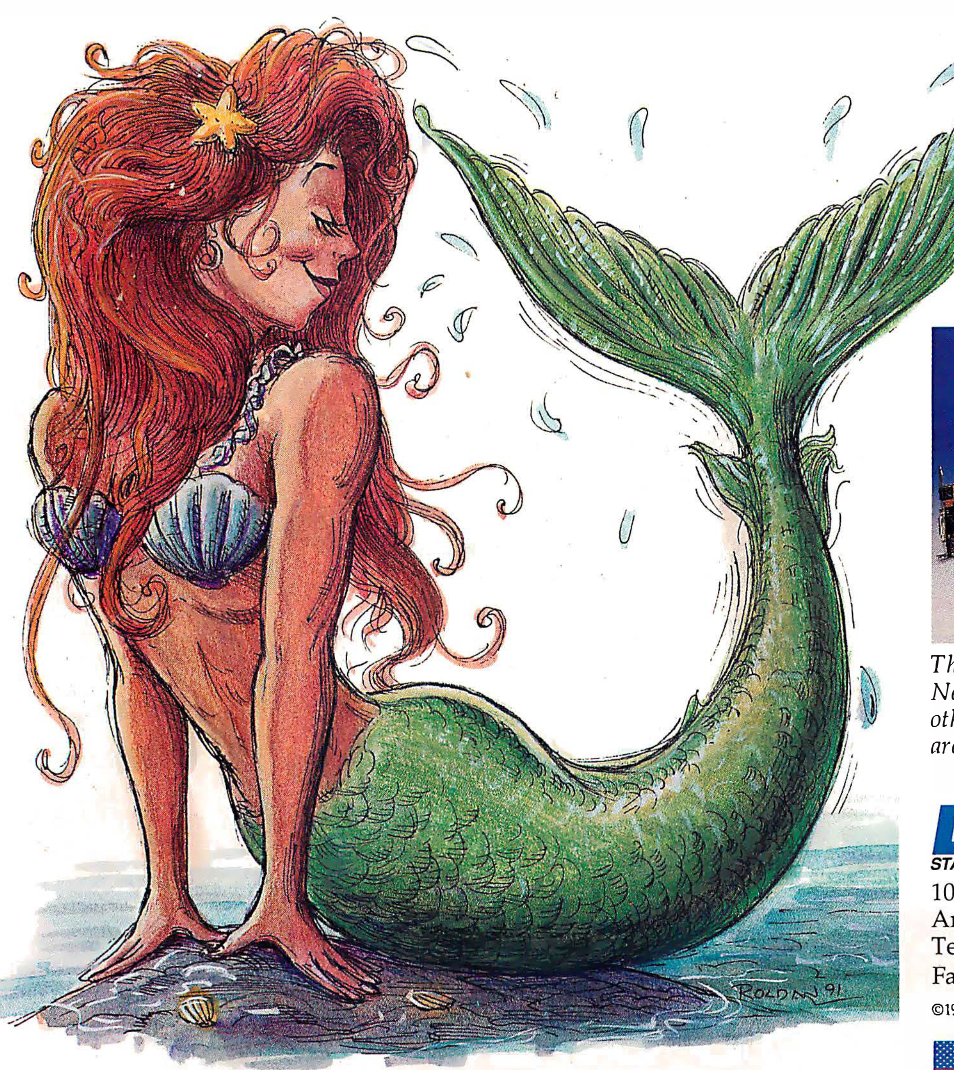
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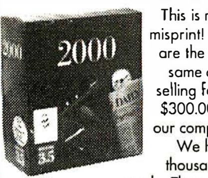


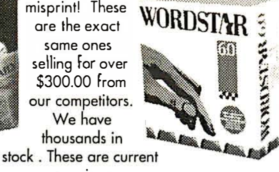
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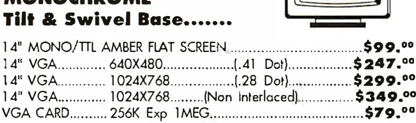
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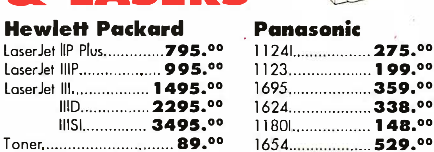
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386SX/20	4MB MODULE	118690-001	**269.00**
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	1MB KIT	108071-001	**119.00**
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DESKPRO 386S	1MB BOARD	113633-001	**139.00**
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	1MB MODULE	113646-001	**79.00**
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DESKPRO 386/20, 25, 286E	1MB MODULE	113131-001	**59.00**
	4MB MODULE	113132-001	**199.00**
DESKPRO 386/20E/25E	1MB BOARD	113644-001	**129.00**
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DESKPRO 386/33, 486/25/33/33L	2MB MODULE	115144-001	**128.00**
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SYSTEMPRO	32MB MODULE	116568-001	**3950.00**

PORTABLES

MODEL	MEMORY ADDED	COMPAQ EQUIV. PART#	YOUR COST
PORTABLE III	512K KIT	107331-001	**38.00**
	INTFC BD	107808-001	**149.00**
	EXP BD	107811-001	**199.99**
	2MB KIT	107332-001	**119.00**
SLT/286	1MB MODULE	110235-001	**129.00**
	4MB MODULE	110237-001	**458.00**
LTE/386S/20	1MB	121125-001	**169.00**
	4MB	121125-002	**419.00**
LTE/286	1MB BOARD	117081-001	**89.00**
	4MB BOARD	117081-003	**398.00**
PORTABLE 386/20	1MB KIT	107651-001	**169.00**
	INTFC BD	107707-001	**88.00**
	4MB BOARD	107653-001	**479.00**
	4MB EXT BRD	107654-001	**479.00**
SLT/386	1MB MODULE	118303-001	**129.00**
	2MB MODULE	118304-001	**219.00**
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TOSHIBA MODEL	MEMORY ADDED	TOSHIBA EQUIV. PART #	YOUR COST
PORTABLE 2000SX	1MEG	PC14-PA8311U	**119.00**
T1000SE & XE/LE	2MEG	PC14-PA8312U	**169.00**
T2000/T2000SX	1MEG	PC18-PA8316U	**119.00**
	2MEG	PC18-PA8317U	**179.00**
T2000SX/T1000LE	4MEG	PC-PA8314U	**329.00**
	8MEG	PC14-PA8315U	**619.00**
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	4MEG	PC-PA2001U	**329.00**
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T1600	2MEG	PC8-PA8302U	**119.00**
T3100E	2MEG	1PC9-PA8340U	**119.00**
T3100SX	2MEG	PC15-PA8308U	**119.00**
	4MEG	PC15-PA8310U	**195.00**
T3200	3MEG	PC6-PA7137U	**219.00**
T3200SX	2MEG	PC12-PA8307U	**119.00**
	4MEG	PC12-PA8309U	**195.00**
T3200SXC	2MEG	PC19-PA8318U	**129.00**
	4MEG	PC19-PA8319U	**249.00**
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64X4	1.95	2.25	2.45	2.95	
256X1	.95	1.05	1.10	1.15	1.95
256X4		3.95	4.45	4.95	5.45
1MEGX1		3.50	3.85	4.10	4.45
1MEGX4				25.00	
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IBM PS/2 MODEL	MEMORY ADDED	IBM EQUIV. PART#	YOUR COST
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PS/2 25/286	512K KIT	30F5348	**38.00**
30-286, 50Z & 55-SX, 65SX	2MB KIT	30F5360	**107.00**
PS/2 L40SX & N33SX	2MEG	79F10999	**128.00**
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PS/2 50Z & 55SX, 65SX	1MB SIMM	6450603	**59.00**
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50, 50Z, 55SX & 60, 65SX	2-8MB BOARD	1497259/6450609	**349.00**
PS/2 70-E61, 061, 121, P70	1MB SIMM	6450603	**52.00**
	2MB SIMM	6450604	**89.00**
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PS/2 80-041	1MB MODULE	6450375	**98.00**
PS/2 80-111, 121, 311, 321	2MB MODULE	6450379	**138.00**
80-A21, A31, A61	4MB MODULE	6451060	**249.00**
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HPIIISI	1MB MODULE	N/A	**79.00**
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SyQuest

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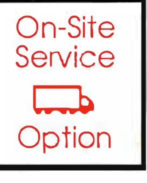
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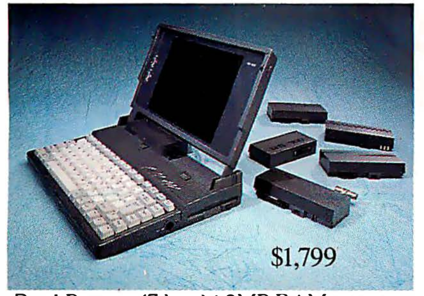
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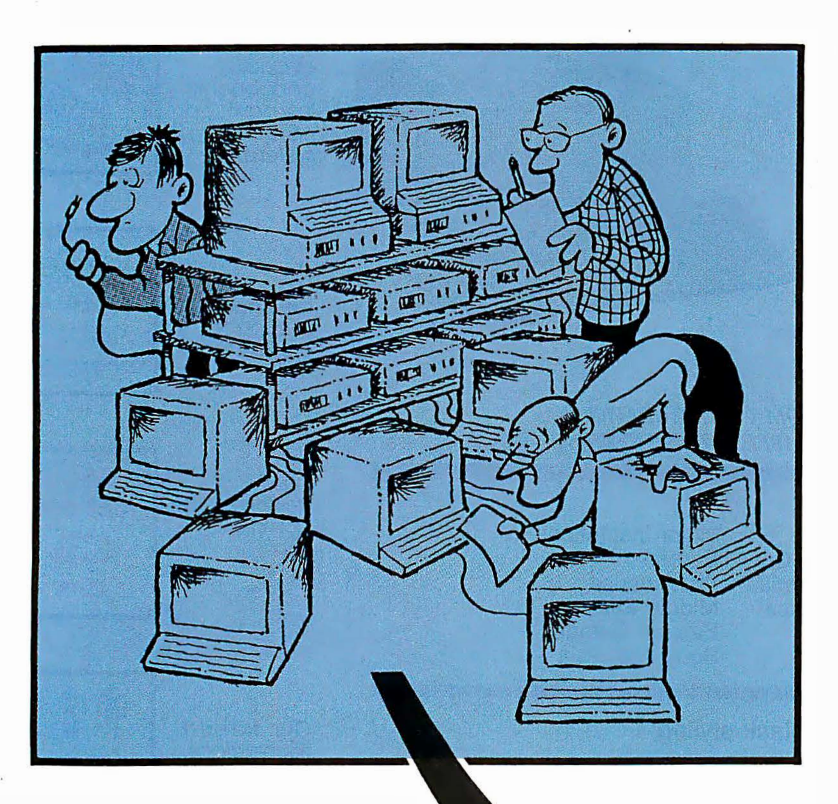
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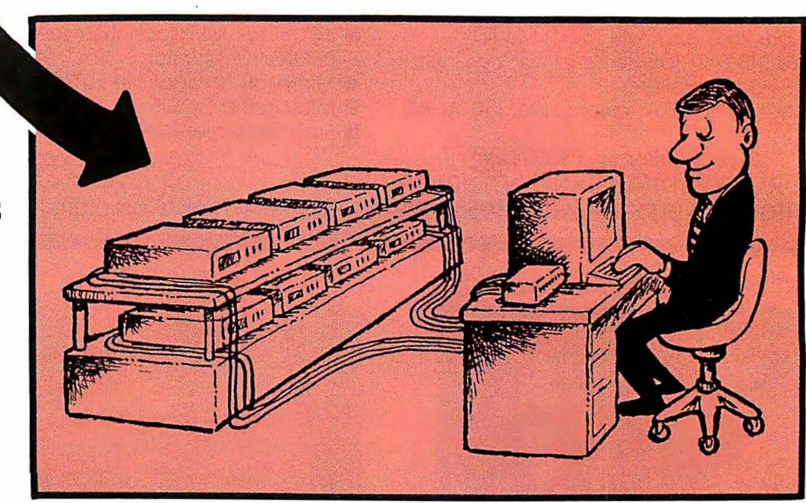
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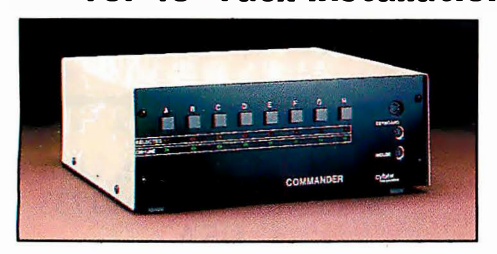
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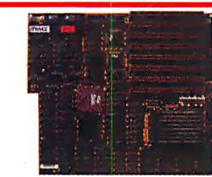
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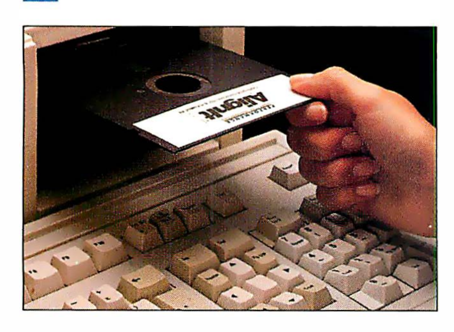
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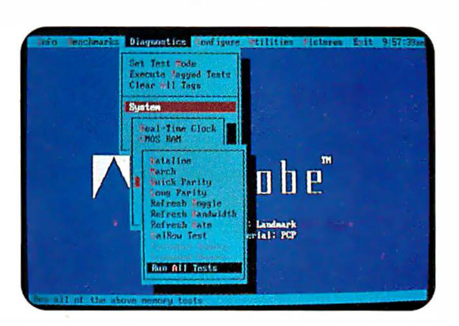
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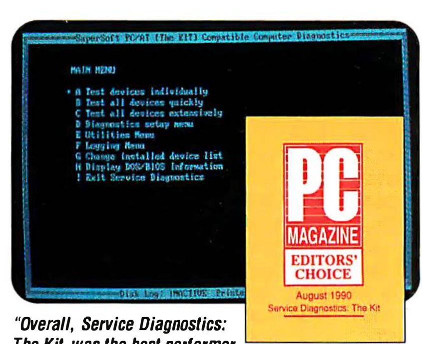
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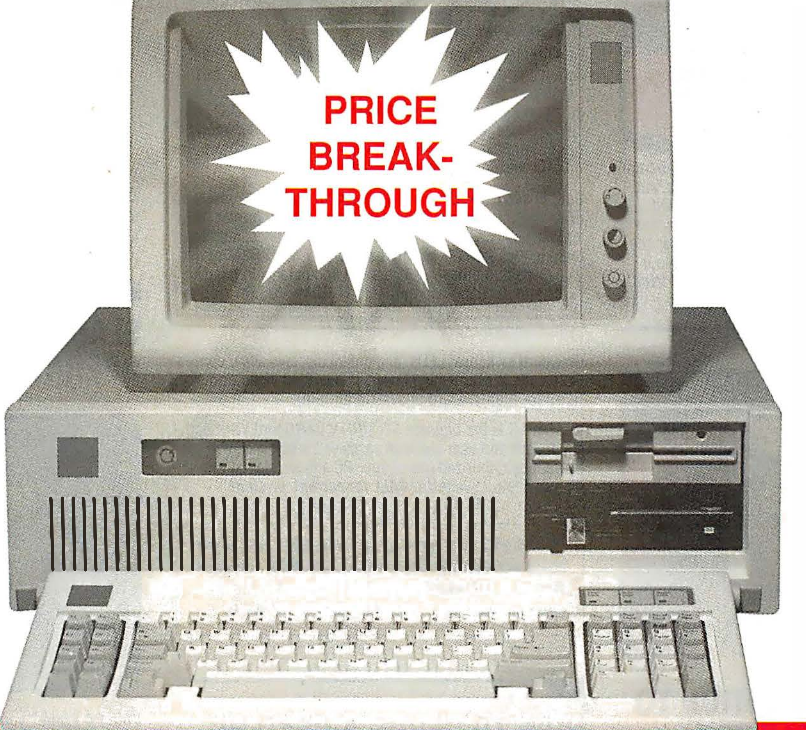


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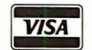
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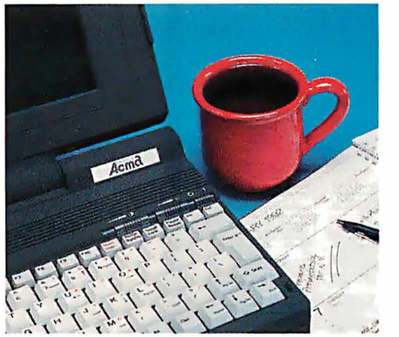
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Prospeed SX/20	1MB BD	159.00
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Prospeed 286	1MB BD	139.00
386SX/16	2MB BD	259.00
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Prospeed 386	2MB CD	259.00
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Slimsport 286e	2MB CD	189.00
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83D87-20	189.00
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Mac Ici,IIsi	4MB Kit	209.00
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Mac IIci,IIsi	16MBKit	629.00
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SX/16	4MB Kit	219.00
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WKST & Bravo	4MB Kit	189.00
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Fastram	512-2MB BD	289.00
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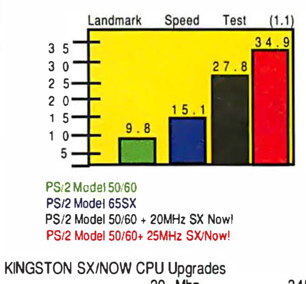
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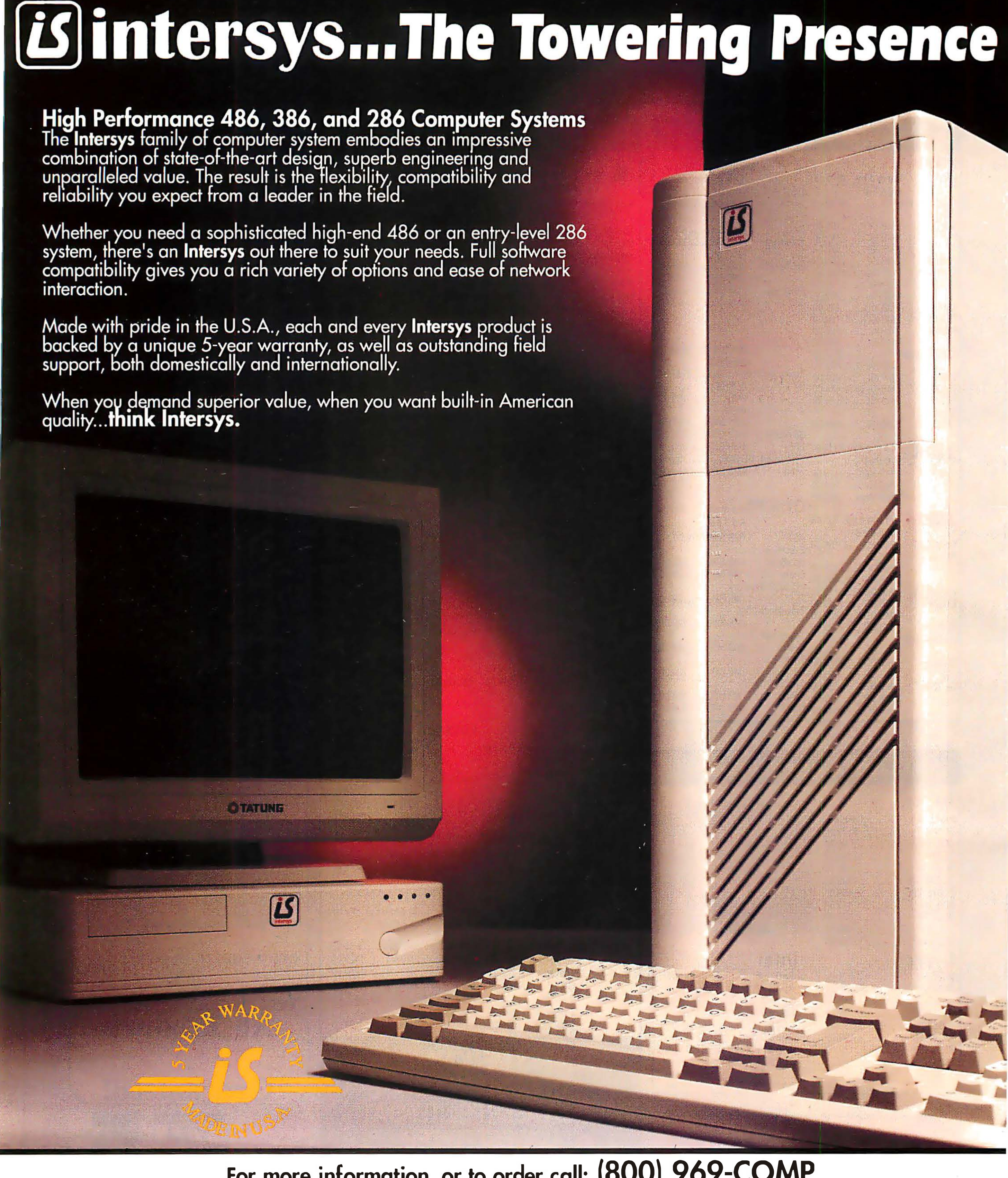
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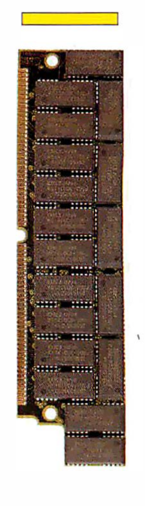
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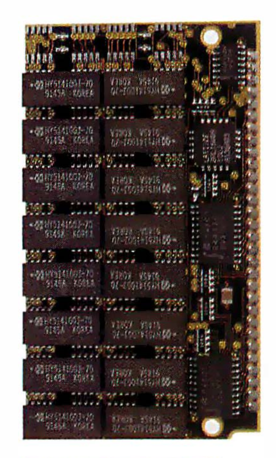
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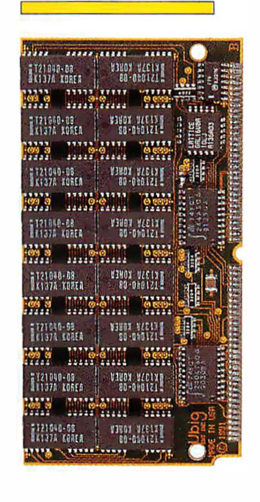
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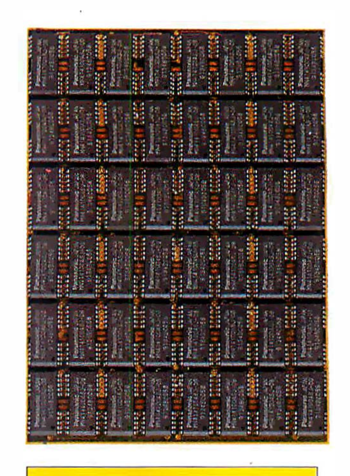




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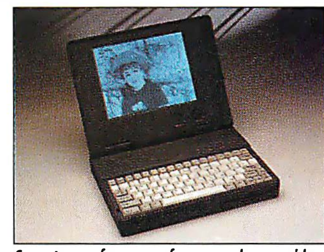
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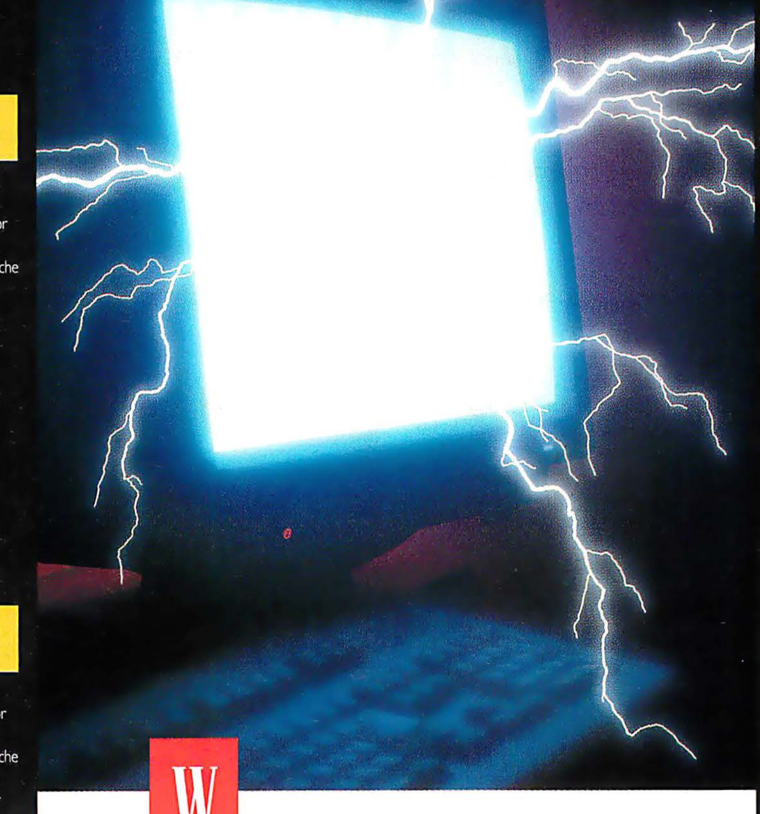
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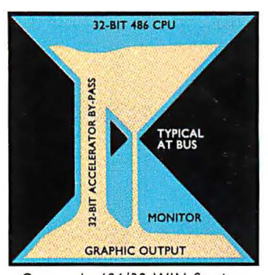
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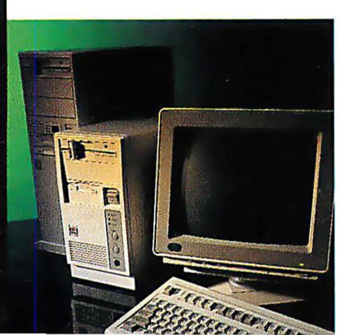
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AST PREMIUM EXEC	386SX/25	60MB *WITH 8MB RAM*	$2,448
AST PREMIUM EXEC	386SX/20	60MB *WITH 8MB RAM*	$2,328
AST PREMIUM EXEC	386SX/20	40MB *WITH 8MB RAM*	$2,078
EVEREX TEMPO/LX	386SX/20	60MB *WITH 5MB RAM*	$2,318
EVEREX TEMPO/LX	386SX/20	40MB *WITH 5MB RAM*	$2,148
SHARP PC-6681		80MB *WITH 6MB RAM*	$CALL
SHARP PC-6661		***60MB WITH 6 MB RAM***	***$2,218***
SHARP PC-6781		80MB *WITH 8MB RAM*	$CALL
SHARP PC-6881		80MB *WITH 8MB RAM (COLOR)*	$CALL
TEXAS INSTRUMENTS TM2000		40MB *WITH 3MB RAM*	$1,468
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TEXAS INSTRUMENTS TM3000	WinSX	80MB/*6MB RAM*	$CALL
TEXAS INSTRUMENTS TM3000	WinSX	60MB/*6MB RAM*	$CALL
TEXAS INSTRUMENTS TM3000		80MB *WITH 6MB RAM*	$2,468
TEXAS INSTRUMENTS TM3000		60MB *WITH 6MB RAM*	$2,388
TEXAS INSTRUMENTS TM3000		40MB *WITH 6MB RAM*	$2,328
TEXAS INSTRUMENTS TM3000		20MB *WITH 6MB RAM*	$2,038
ZENITH MASTERSPORT 386SLE		60MB *WITH 8MB RAM*	$3,898
ZENITH MASTERSPORT 386SL		60MB *WITH 8MB RAM*	$3,228
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PANASONIC CF-270 60MB HARD DRIVE UPGRADE	$648
SHARP PC-6220 40MB HARD DRIVE UPGRADE	$548
TANDY 2810-HD 60MB HARD DRIVE UPGRADE	$648
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NOTE: All hard drive upgrades are supplied with a new BIOS whenever necessary, and come with a full one-year warranty.

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T5100	40MB *WITH 4MB RAM*	$1,598
T4400SX	80MB LCD *WITH 10MB RAM*	$4,708
T4400SX	80MB GAS PLASMA *WITH 10MB RAM*	$CALL
T3300SL	80MB *WITH 10MB RAM*	$CALL
T3200SXC	120MB *WITH 13MB RAM*	$CALL
T3200SX	120MB *WITH 13MB RAM*	$CALL
T3200SX	40MB *WITH 13MB RAM*	$CALL
T3100SX	80MB *WITH 13MB RAM*	$2,958
T3100SX	40MB *WITH 13MB RAM*	$2,298
T2200SX	80MB *WITH 10MB RAM*	$3,968
T2200SX	60MB *WITH 10MB RAM*	$3,748
T2200SX	40MB *WITH 10MB RAM*	$3,528
T2000SXE	60MB *WITH 10MB RAM*	$2,998
T2000SXE	40MB *WITH 10MB RAM*	$2,758
T2000SX	60MB *WITH 9MB RAM*	$2,778
T2000SX	40MB *WITH 9MB RAM*	$2,558
T2000SX	20MB *WITH 9MB RAM*	$2,448
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T1600	20MB *WITH 5MB RAM*	$1,338
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T1200XE	40MB *WITH 5MB RAM*	$1,968
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TOSHIBA T1200XE/T5100 2MB UPGRADE...$98

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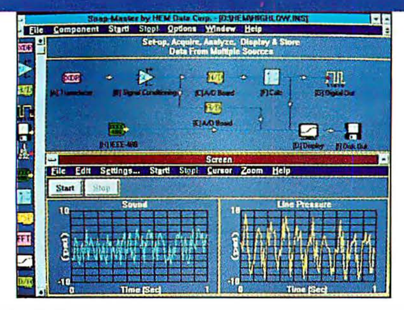
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NEW Snap-Master Software: Data Acquisition for Windows

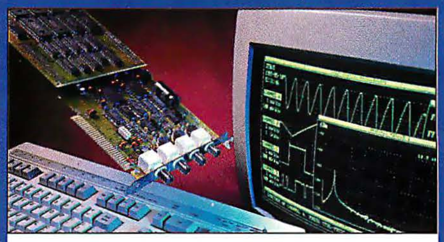
Discover Snap-Master — the only Windows-based data acquisition and analysis software to achieve high-speed, real-time data acquisition with multiple simultaneous A/D boards.

Snap-Master lets you define your own custom instruments using icons and easy-to-understand flow charts. A pre-defined database of sensors is integrated with the data acquisition system.

#HDS 200 Snap-Master Acquisition Module **$995**
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Use modules as an integrated package or stand-alone

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100 MHz PC-Based Scope

CompuScope 250 from **Gage Applied Sciences** is a family of high quality 100 MegaSPS PC/XT-compatible Data Acquisition Cards with advanced oscilloscope software. Features include:

- 100MHz sampling on one channel or 50MHz simultaneous sampling on two channels
- 8-bit resolution
- 50MHz bandwidth
- 32 or 128-KiloByte memory buffer
- Programmable gains
- Store and load setups and signals
- Drivers available in C, Pascal and Basic.

#DSO 250L 100MHz CompuScope 250 Lite....**$2750**
#DSO 250-32 100MHz Scope w/32K Buffer.......**$3495**
#DSO 250-128 100MHz Scope w/128K Buffer.....**$3895**

VGA to your VCR



Tape VGA Animation

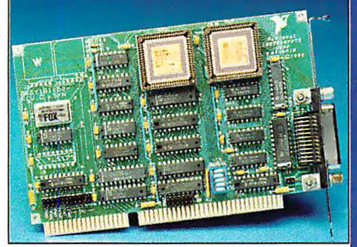
Redlake TapeCaster VGA to Video Converter

Redlake's **TapeCaster** converts VGA screen output to video for applications such as animation and creating training tapes. The TapeCaster is extremely easy to use: no base addresses, no interrupts, no software — just plug and play.

- True, precise NTSC or PAL video timing.
- Simultaneous VGA and video display.
- Composite Video & Y-C (SuperVHS) output for use with equipment ranging from an inexpensive VCR to broadcast-quality professional video.

#NTSC 200 TapeCaster – NTSC Video Output **$750**
#PAL 200 TapeCaster – PAL (Europe) Video Out. **$750**
#NTSC 100 NTSC Video Digitizer w/software **$1650**

New GPIB Controllers Support IEEE-488.2 Standard

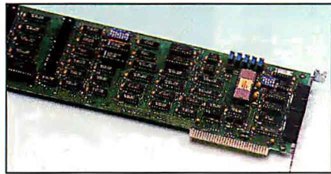


The new IEEE-488.2 standard has made it easier than ever to program and control GPIB devices. Manufactured by **National Instruments**, these boards allow you to control and gather data from up to 15 devices with IEEE-488 interfaces. Our **AT GPIB** and **Micro-Channel** controllers support data transfers at up to 1 Million samples/second. (No re-writes! Older software fully supported!)

#INST 1000A Standard GPIB Controller with IEEE 488.2 Support........................**$395**
#INST 1004 AT-Bus, 1 MHz Turbo GPIB Controller..**$495**
#INST 1011 Micro-Channel, 1 MHz Turbo GPIB Controller...................................**$495**

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Low-Cost Data Acquisition with the PCL 812

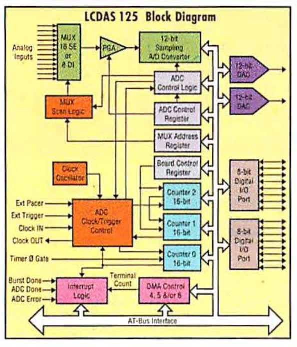


Advantech has made data acquisition extremely affordable. Their PCL 812 boards offer 16 input channels and high speed acquisition; despite their low cost these boards have not sacrificed anything in terms of performance or advanced capabilities.

- 16 Single-Ended Analog Input Channels and 2 Analog Output Channels.
- Up to 30,000 Samples Per Second with 12-bit Resolution.
- 16 Digital Input Lines and 16 Digital Output Lines

#PCL 812 30KHz, 16-Channel, Low-Cost A/D Board w/ BASIC Drivers.............**$395**
#PCL 812G PCL 812 with Software-Programmable Gain Levels..........................**$495**
#PCL 1100 Pascal and C Software Driver Package..**$95**
#PCL 780 Interface Terminal Panel with Included Cable.......................................**$95**

You CAN Have it All!



Low cost and high perfromance now go hand-in-hand. The new LCDAS series of Data Acquisition boards from **Analogic** give you all of the features of boards costing several times more money. Dual DMA processing combined with a full 16-bit AT-bus interface lets you process data as fast as your LCDAS board can sample it. A quick glance at the Block Diagram will show you that all recommended internal circuitry has been provided. Free software drivers and extremely flexible control of operating modes makes development efforts a breeze.

#LCDAS 50 50KHz, AT-Bus Data Acquisition Board..**$499**
#LCDAS 125 125KHz, AT-Bus Data Acquisition Board **$650**

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- **Connect your PC to Test Instrumentation with IEEE-488, RS-232, RS-422**
- **Stepping and Servo Motor Control with your Personal Computer**

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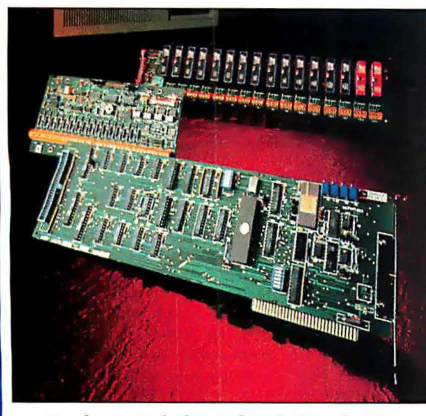
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Please fax a request for quotation listing brand and/or performance requirements, and we'll fax back a prompt response.

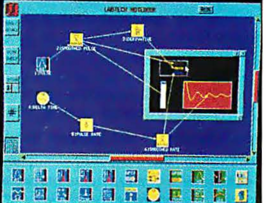
CyberResearch System of the Month Features RTI DAS from Analog Devices



Package includes Labtech Notebook

The **RTI** series of data acquisition boards were designed by **Analog Devices** with industrial users in mind. With the lowest MTBF in the industry, these are the boards to chose when reliability is critical. Designed from the outset to be compatible with the full line of Analog Devices' signal conditioning modules, these boards can be used for the broadest possible range of data acquisition applications.

CyberResearch has now made this top-of-the-line product affordable for everyone. By bundling an **RTI 815A** together with **Labtech Notebook** software at one low price, we've saved over $500 and made it possible for you to afford the very best.



Labtech Notebook

Each combination package contains:

- **RTI 815A** DAS board configured for 32 S.E. or 16 Diff analog input channels with 50KHz A/D conversion rate, 2 analog output (D/A) channels, 16 Digital I/O and 3 Counter/Timer I/O.
- **Labtech Notebook** menu-driven software with new IconView diagramming user interface and drivers for the RTI 815A board.

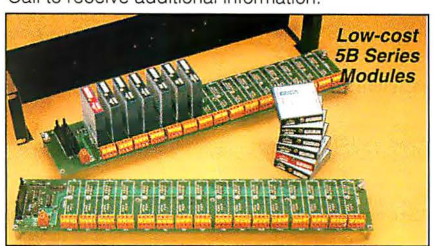
#RTI 815LN RTI DAS Combination Package.....**$1995**

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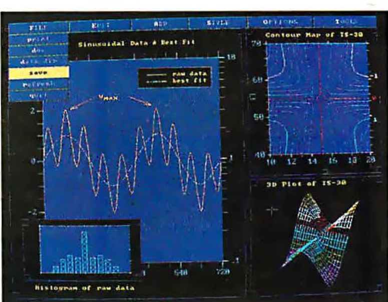
The DAS 16 analog converter board has always set the standard for PC-based data acquisition. **Keithley Metrabyte** has now set a new standard for price and performance. A total redesign using ASIC architecture has resulted in complete backwards compatibility, reductions of cost, size, and power consumption, and the addition of many new features, including:

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#DAS ASO Advanced Software Option – Windows, C, Visual Basic Drivers **$195**

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EasyPlot II Scientific Graphing Software



Are you tired of using Lotus to create scientific plots? Now **EasyPlot II** helps you create complex graphs and detailed 3-D plots from your data. Easy-to-use **EasyPlot II** is completely menu-driven. Analysis functions, unlimited display options and journal-quality output make this the package of choice. Makes a perfect companion to our Labtech Notebook data acquisition software.

#SPS 215 EasyPlot II Scientific Plotting and Graphing Software........................**$349**

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Rack-mount printers manufactured by **Syntest** are IBM Proprinter compatible for easy software compatibility. The Epson dot-matrix print head is driven by a fiberglass belt and high resolution stepper motor for near-perfect dot alignment. The absence of gears and cams reduces the parts count and results in a high MTBF. A rugged 1/8" aluminum shell protects the mechanism from harsh environments. Choose Serial (RS-232), 4-20mA, Parallel, or RS-422/485 connections for great cabling flexibility.

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#PRO 500 Ruggedized Rack-Mount Dot-Matrix Printer **$1350**
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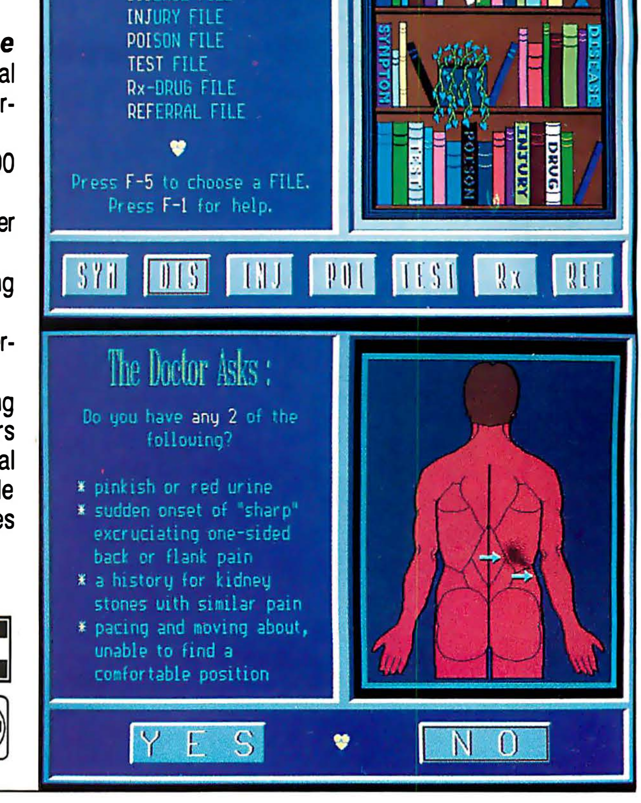
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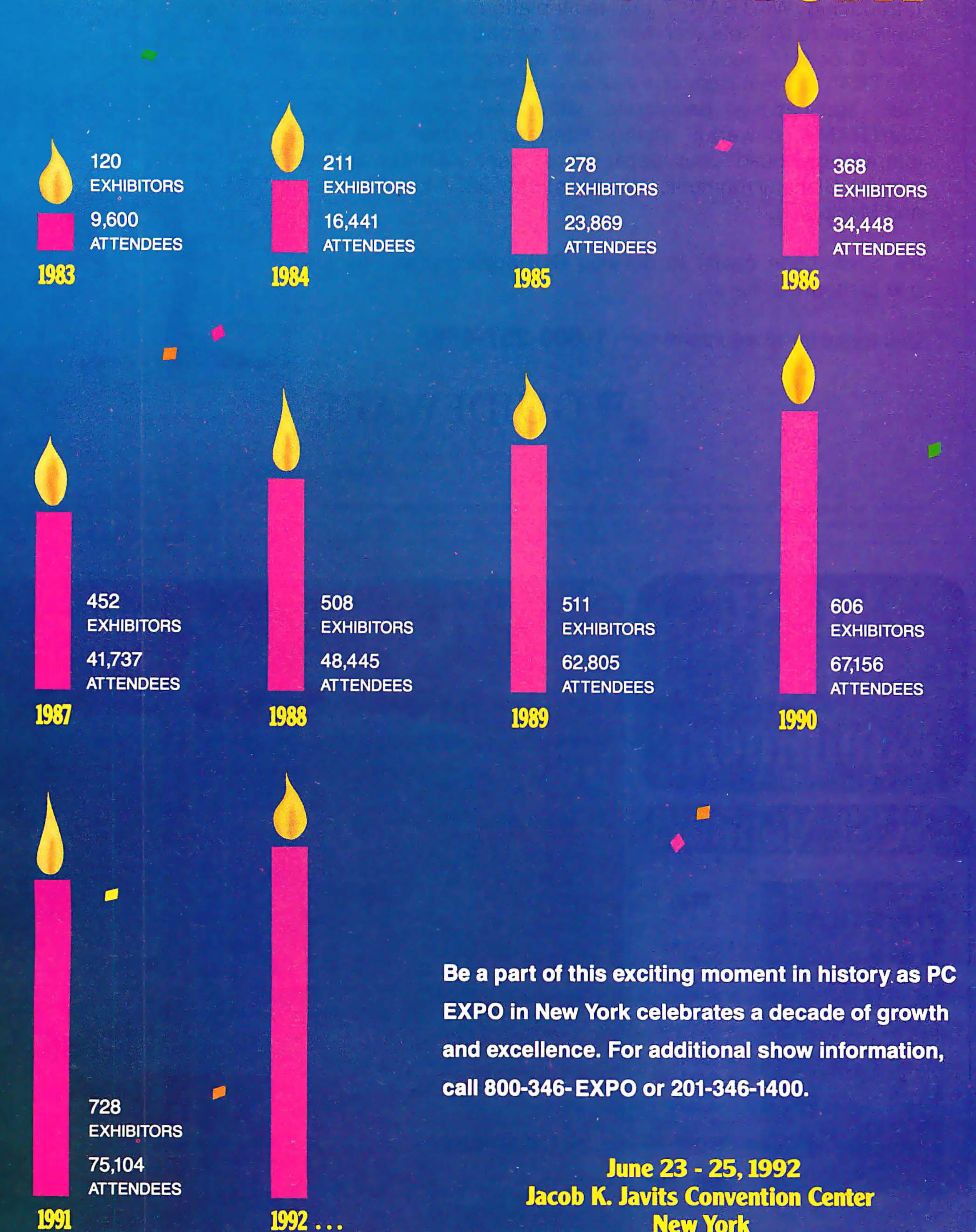
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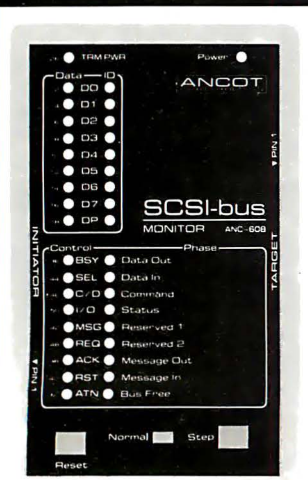


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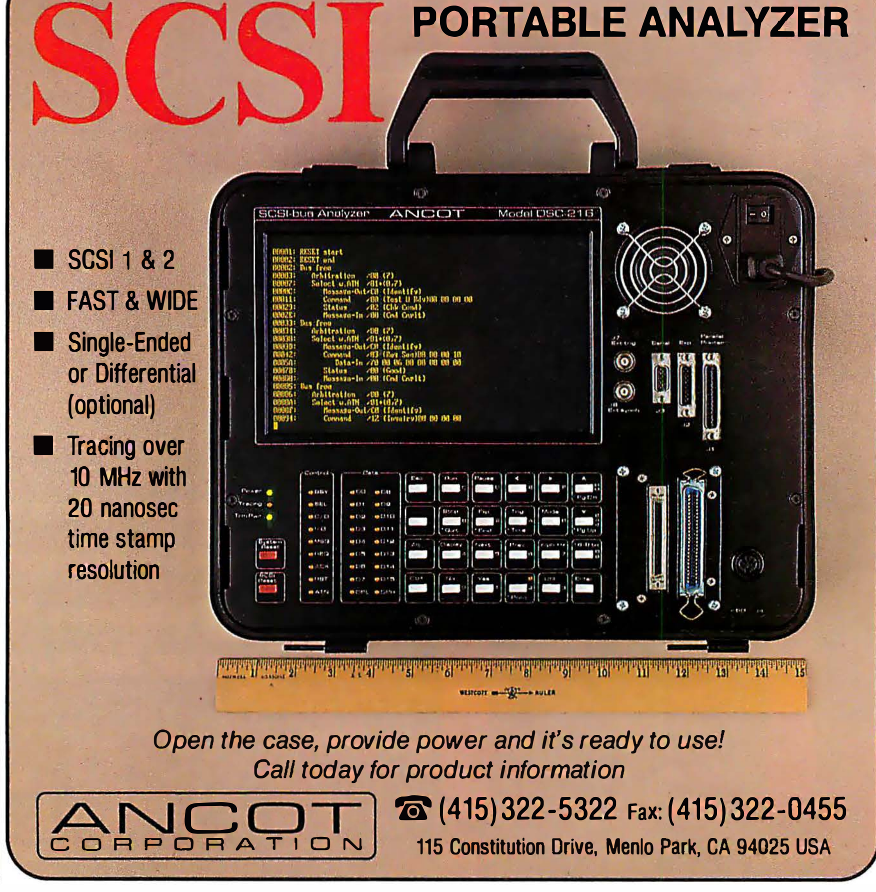


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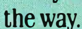
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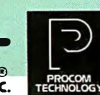










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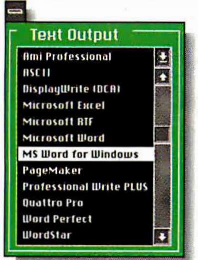


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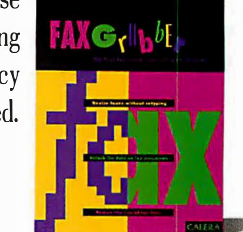
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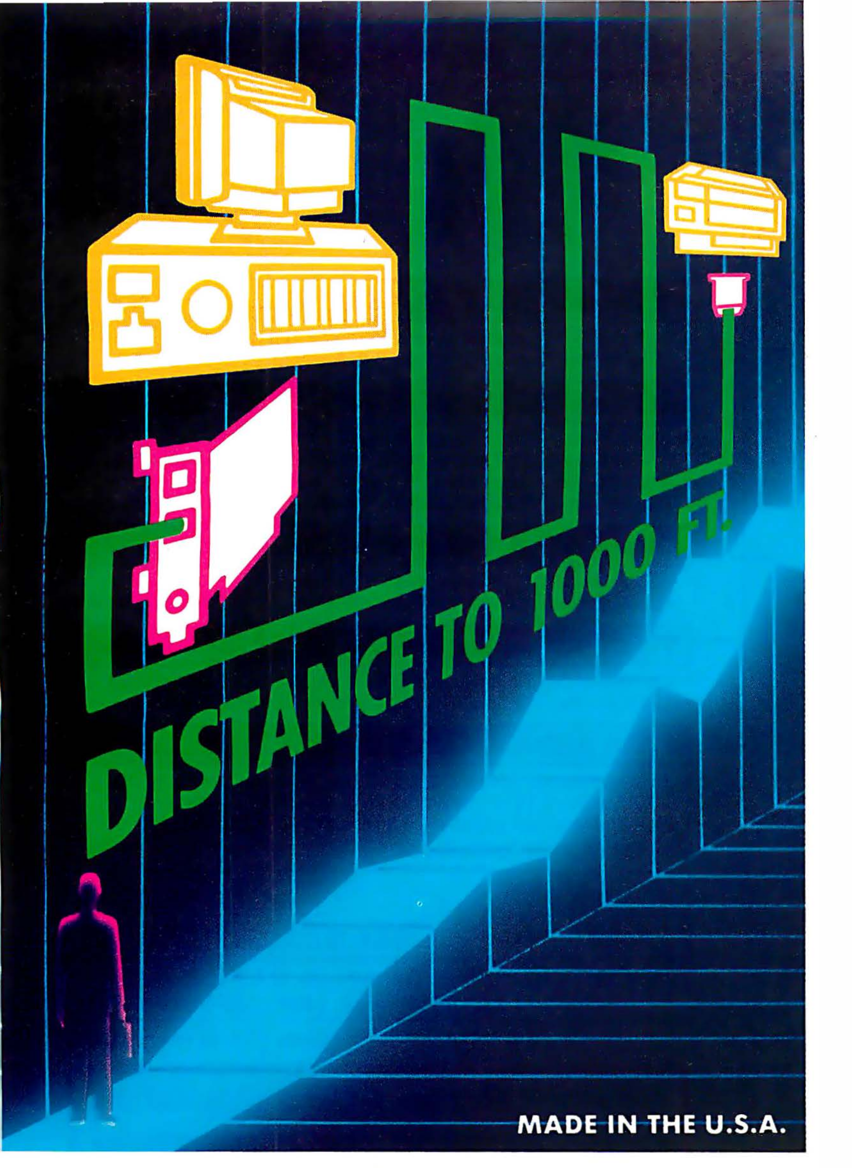
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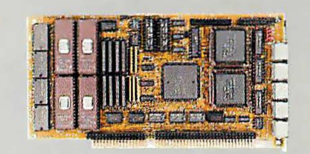


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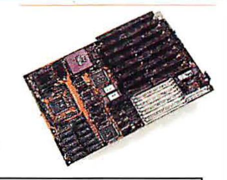
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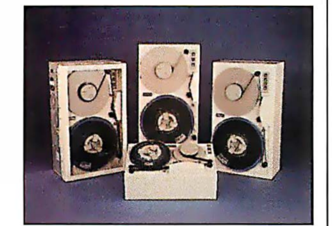
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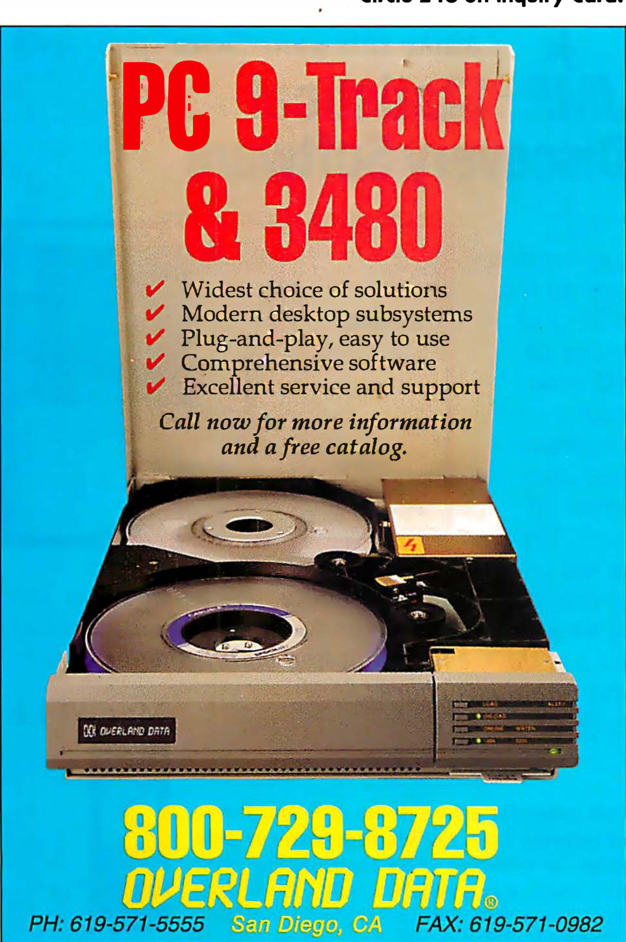
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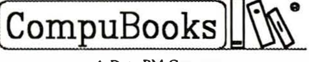
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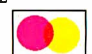
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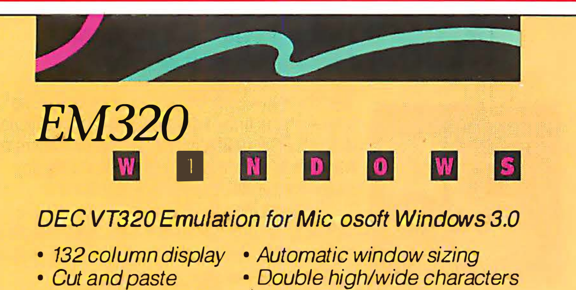
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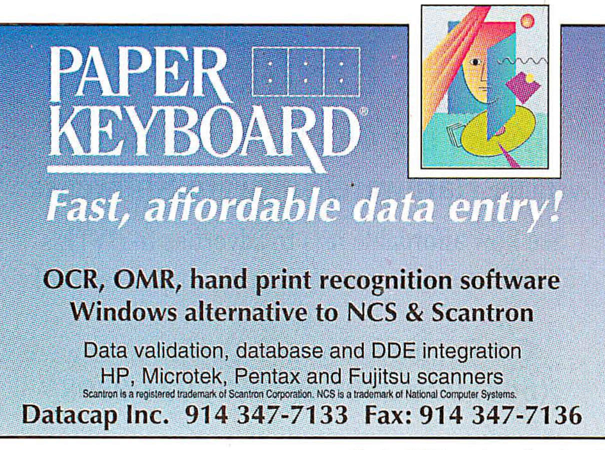


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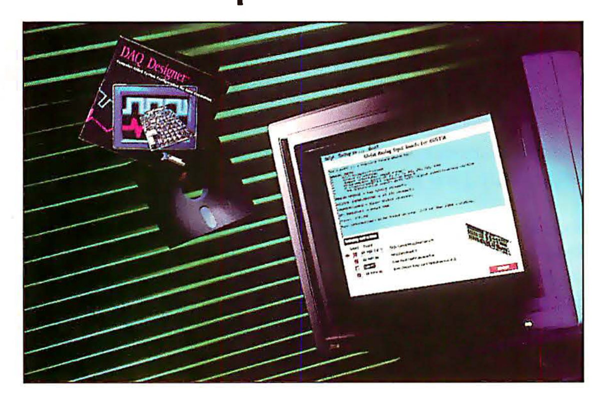
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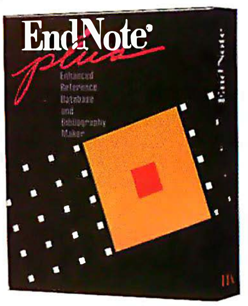


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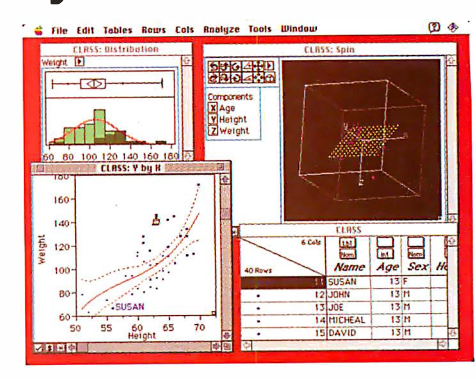
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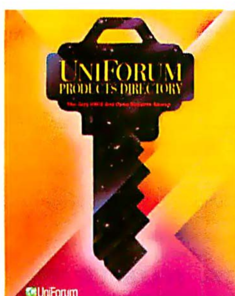
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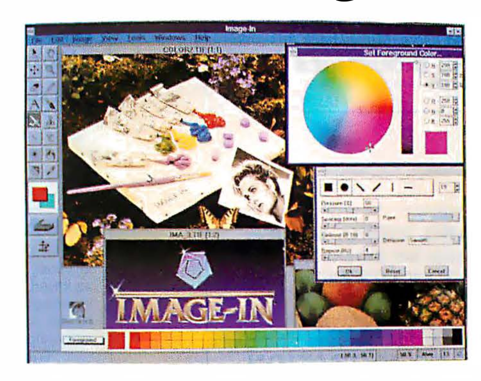


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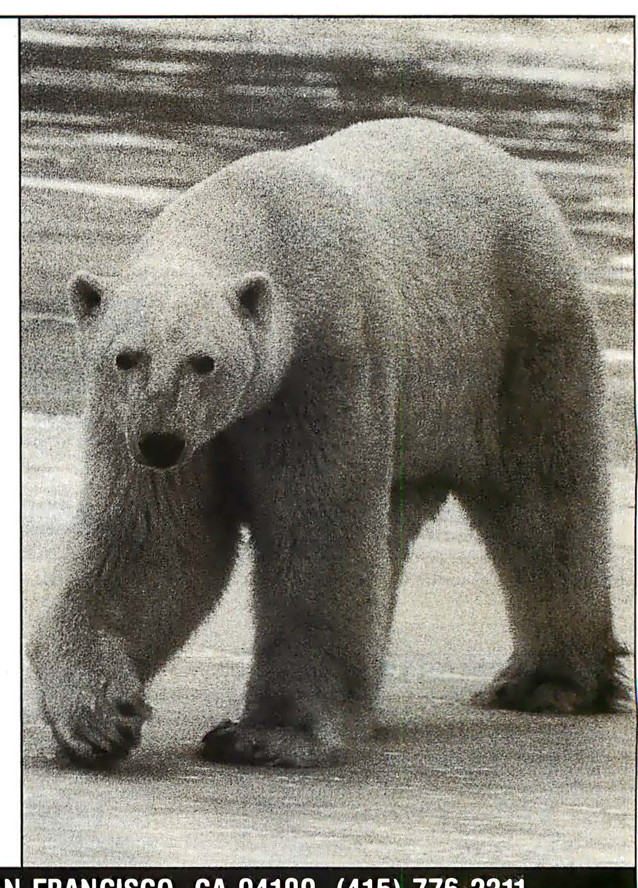
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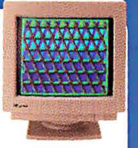
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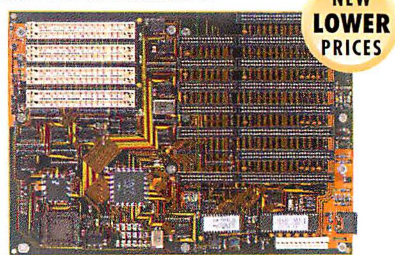
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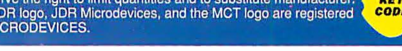
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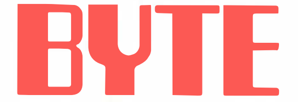


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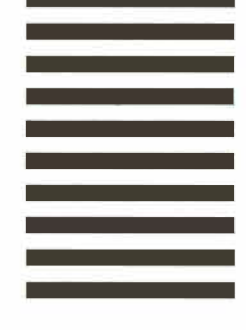
Circle the numbers on Inquiry Card which correspond to inquiry numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "E".

Print Your name and address and mail, or fax to 1-413-637-4343

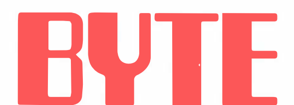






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USA

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TITLE

COMPANY

ADDRESS

CITY STATE ZIP

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A. What is your primary job function/principal area of responsibility? (Check one.)
1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

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McGraw-Hill Publishing Co.
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Index of companies covered in articles, columns, or news stories in this issue.
Each reference is to the first page of the article or section in which the company name appears.
IS pages appear in the International and UK editions; UK pages appear in the UK edition.

PRINT QUEUE

HUGH KENNER

Ways to Keep It Lucid

There's more to desktop publishing than meets the eye

Gabble-gabble, as in the old CP/M manuals, wasn't written *for* anybody; just "for the record." But a writer ought to envisage a breathing person. The first question should be, "Who'll want it?"

No, rephrase that. People may not know they want it. Let's hope luck will steer them our way. In that hope, the writer's guiding question becomes, "Who needs it?"

Example: You've combined a PC with, say, WordPerfect and a laser printer. Your modest intent is to generate good-looking term papers. You naturally assume you're using an automated typewriter. "Wrong. Professional typesetters know things we don't.... The purpose of this book is to let you in on some of the secrets that have been used for centuries to make type pleasing, beautiful, readable, legible, and artistic—secrets we just weren't taught in Typing 1A." If you lighted on that passage, you were lucky.

It's from the page headed "Read me first" in a book called *The PC Is Not a Typewriter* by Robin Williams. The very look of that page helps Williams make her first point; the book, we're told, was itself produced on a PC. One guiding theme: A typewriter's conventions (e.g., two spaces at sentence breaks, underlining for italics, and dittos for quotation marks) derive from a small set of characters, all the same width. Proportional spacing leaves such dodges looking terrible. Eighteen short chapters show us what we need to know; more important, they convince us, visually, of our need to know it.

James Felici's *A Desktop Style Guide* contains information of the same order, but it seldom makes you imagine you're being talked to. It's "a quick reference, one to keep on your desk next to your dictionary." A sentence informs us, "Punctuation marks, including periods, commas, and semicolons, should be followed by only one word space." That's the substance of a whole chapter by Williams. ("Word space" means the space you leave after a word, as distinguished from the gaps between letters, which you'd not be aware of till you'd gotten as far as "kerning," by which time you're an advanced student already.) No, not that he is crabbed or she verbose; it's just that she has a reader in mind, still typewriter-oriented, whereas reference manuals assume you know what you're after.

Visit a different niche for another model opening: "Object-oriented technology is arguably the most exciting and least understood development in software today. Given the amount of hype coming from both media and manufacturers, it's hard for corporate managers to assess its true potential." Managers will need that understanding to decide about investing in a massive switchover. In *Object-Oriented Technology: A Manager's Guide*, David A. Taylor offers a crisp 146 pages of help. It's the best overview of object-oriented programming I've found.

Each paragraph in Taylor's nine chapters has a summary in the margin: "Corporations are drowning in data"; "The failure lies in software"; "Most software is delivered late and over budget"; "We need better software, and we need it faster." That's a neat device for tracking the argument. The diagrams are neat, too. So is a crisp paragraph like this: "It's possible to be quite conversant in 'object-speak' using no more than ten basic terms." (He lists them.) "The appendix at the back of this guide defines these ten concepts." (As it does, with clarity.)

What makes the book exemplary is Taylor's exact conception of just what order of help he's offering to whom. We nonmanagers may profitably eavesdrop.

And in *Advanced Windows Programming*, Martin Heller informs the intrepid that whereas "hello, world" in C needs but five lines, even counting two brackets, the equivalent Windows version uses 80-odd lines in three files. Clearly, we're venturing into something deep; Heller adduces "the dreaded map designation terra incognita" that confronted fifteenth-century sailors.

Those sailors were committed to getting somewhere. Likewise, Heller assumes a reader committed to achieving something venturesome but needing help with vast unknown areas; Windows programming is a *very* new discipline. Fresh from braving such seas himself, he's comfortable with an author-reader relationship subsumed by "we." We readers are comfortable, too.

Toy programs make points but seldom do anything useful; no one ever pretended that "hello, world" had a use, apart from illustrating elements of syntax. In the real world of Windows, code size is an overarching concern, so we'll work on a long program (an image processor). Most of the book shows how it's developed, chunk by chunk.

I've never used Windows, and know little of C, but I didn't need to spot BYTE's Barry Nance in the list of "beta readers" to feel confident. Deft exposition—not syntactic smoke and mirrors—has an authority you can't mistake. Heller's work, like the others, is serene in its understanding of whom it's for and why. ■

The PC Is Not a Typewriter, Robin Williams, Peachpit Press, 1991, $9.95, 92 pp., ISBN 0-938151-49-5.

A Desktop Style Guide, James Felici, Bantam, 1991, $11.95, 129 pp., ISBN 0-553-35445-0.

Object-Oriented Technology: A Manager's Guide, David A. Taylor, Addison-Wesley, 1991, $19.50, 146 pp., ISBN 0-201-56358-4.

Advanced Windows Programming, Martin Heller, John Wiley & Sons, 1992, $32.95 ($72.90 with disks), 370 pp., ISBN 0-471-54711-5.

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. He writes for publications ranging from the New York Times *to* Art & Antiques. *His recent books include* Mazes *and* Historical Fictions. *He can be contacted on BIX as "hkenner."*

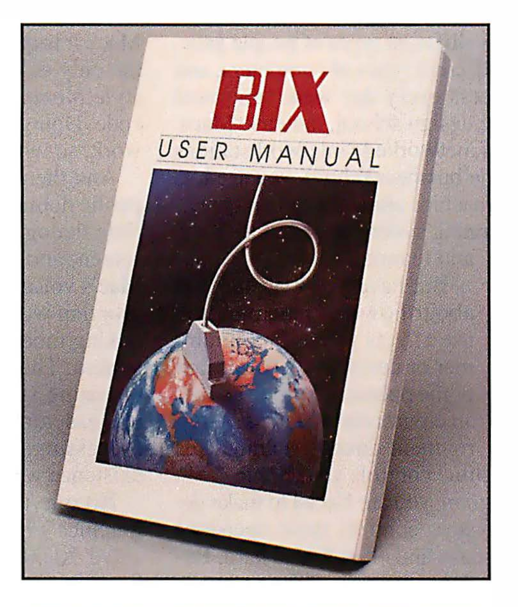
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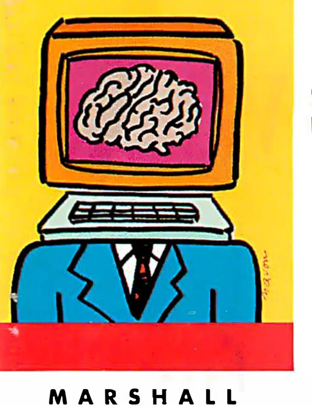
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STOP BIT

MARSHALL BRAIN

HIDDEN PERSUADERS

The computer you use has a strong effect on how you work and think

We all know how different types of people gravitate toward different types of computers, and I see this process every day walking around campus. In the design school, they use Macs. In engineering, networked Unix workstations dominate the scene. In the business school, you see lots of PCs and clones. Each machine attracts a certain type of person because of its operating system, applications base, and features.

But have you ever thought about how the machine you use affects you as a programmer or developer? The design of the operating system creates an environment, and this environment directly manipulates your thoughts. Your machine controls your brain.

When you create a program, you are forced to make decisions. The operating system controls those decisions by making certain things easy and other things hard. Being human, we tend to go down the easy path as often as we can, and this directly affects the code and applications that we create on a given machine. All you have to do is look at the applications and utilities on a system to see the long-term effects of these paths.

Take, for example, TSR programs on the PC. Where in the world did they come from? There were none, then there was Sidekick, and then there were a thousand of them almost overnight.

DOS contains a function—the terminate-but-stay-resident function—that lets a piece of code be loaded into memory permanently. Another part of DOS makes it possible for the programmer to inspect incoming keystrokes in the background so that a certain hot-key sequence can be used to activate the TSR even if another application is loaded and running. As soon as someone figured this out, TSRs exploded onto the scene.

Of course, there is a downside to the TSR capability: It makes viruses easy to create as well. And, as you might expect, they also exploded. Unix makes viruses much harder to create so you rarely see them there.

Here's another example. You are writing code and you want to do a `malloc(4000000)`—an allocation request for a 4-MB block of memory. The PC laughs at this request. So does the Mac. But Unix says, "OK." You can bet that controls the way people think! Having access to an almost unlimited memory space changes your brain. It is very freeing.

What about the much-heralded "look and feel" of the Mac? It is quietly imposed on any developer because it is the only easy way to do things. You can create a Mac-style menu, button, or dialog box with a few lines of code. Doing things any other way would take months of work, so why bother?

And then there is the case of the talking moose. This public domain program runs on a Mac. Every so often, a little dialog box with a moose head in it pops onto the screen, and the moose says something witty using the Mac's voice-synthesis library. Many people who see this program wonder why. I believe that the existence of the talking moose was preordained by the Mac's operating system. The talking moose *had* to be created. Given an operating system that contains a voice-synthesis module, easy drawing and animation facilities, background processing, and desk accessories, the talking moose's existence was as predictable as frost on a cold morning.

No one thought about rotating three-dimensional graphics when computers were as big as barns and executed 20,000 instructions per second. But in a 20-million-instruction-per-second world, 3-D becomes possible, and people think about it all the time. If the operating system supplies a set of canned routines that make it easy, everyone will use it.

Don't be fooled into underestimating the system's effect on you. For example, I distinctly remember seeing a Mac for the first time. I was in college, and three of us piled into my pickup truck to go see the one Mac in Albany, New York. I remember sitting down and using the spray-paint tool in the original MacPaint and feeling my brain explode. It was amazing! You could do *anything* with this machine. I had never even conceived of the things this machine could do, which shows how much of a constraint the PC had put on my mind. It is hard to have graphical dreams in a textual world.

The choices you make as you are creating an application are directly controlled by the environment you work in. Choose carefully. ■

Marshall Brain is a faculty member at North Carolina State University and the author of Motif Programming: The Essentials and More *(Digital Press). You can reach him on BIX c/o "editors."*

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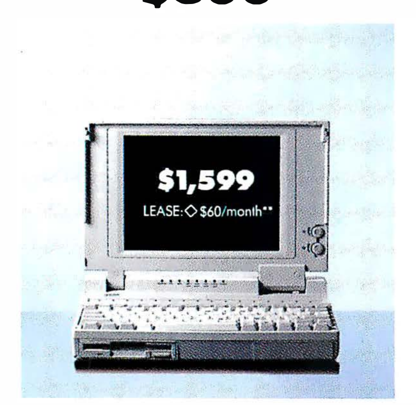
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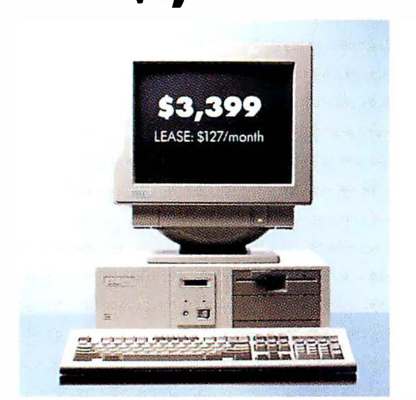
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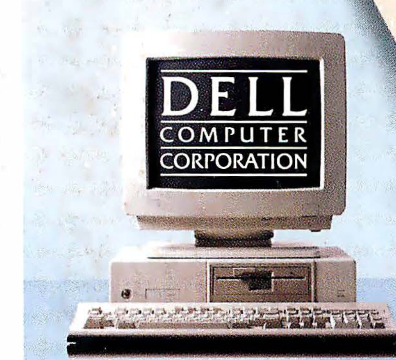
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